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a record of research

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HUMAN BIOLOGY

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DECEMBER, 1929

THE SICK MAN*

BY WARFIELD T. LONGCOPE, M.D.

The Johns Hopkins Medical School

The subject which has been proposed as the fundamental theme for these lectures permits of innumerable variations, but each one of us, who develops it independently and in his own fashion, must include echoes or even repetitions of what has gone before. There are certain dominants that will recur over and over again, and indeed this must be so, in order that the mere reiteration brings you to the point of believing that the idea springs from your inner consciousness. No doubt many of the thoughts expressed in this paper have come through some such unconscious plagiarism, and consequently we have at the very start a bond of sympathy.

No one can remain unconscious today of the extraordinary material benefits derived from organized and systematized methods of work, nor can any of us live uninfluenced by them. We depend on an elaborate system of production and distribution for our daily bread, our clothes, our automobiles, our telephones and our radios. We are forever harping on the fact that this is a scientific age; and, with more enthusiasm than discrimination, mistake methods for ideas, and confuse experimental science with applied science. What most of us applaud is not science itself but the ingenuity that utilizes scientific methods and discoveries for practical purposes. The worth of the true knowledge of any natural phenomenon has come to be

* Delivered on October 23, 1928, in the series of lectures on the Care of the Patient at the Harvard University Medical School.

measured by the cease and rapidity with which it can be made available. Such an attitude of mind is demoralizing to the serious student of nature.

Medicine owes a debt, almost inestimable, both to abstract scientific investigation and to the practical application of the fundamental truths laid bare by such investigations. Applied science in the form of hygiene and preventive medicine has been of far more benefit to mankind, perhaps, than any other single branch of human activity. In general terms, these applied sciences have kept the earth inhabitable; and in more specific terms they have brought health and happiness to each of us as citizens.

Those of us, for instance, who can remember the days when typhoid was a scourge throughout this part of the world, cannot cease to be grateful for the persistent, and finally effective, efforts that led to the purification of our water supplies. It is an old story, of course, but none the less dramatic. For years, our grossly contaminated water supplies were a national disgrace. Early in the century the hospitals in Philadelphia, where I was then working, were crowded with cases of typhoid. In one hospital there was an average of six hundred cases a year, and during severe outbreaks it was not uncommon to care for a hundred or more cases at one time. Small wards were often reserved for the seriously ill patients, while in the larger wards lay the convalescents, emaciated gaunt specters of human beings, for this was before the days of high calory feeding, recovering slowly from their long illness. But happily many changes have taken place in these intervening years. Today, one has to search in late summer or early autumn for a patient with typhoid, so that the students may see with their own eyes the "rose spots" of which they have read so much. One cannot have lived through this miraculous transformation without acquiring great faith in the efficacy of the measures employed by the hygienist. There is yet much to be done, ever new epidemics to fight, ever new problems to tackle that threaten' the health of communities, always the necessity for vigilance lest carelessness should spread destruction when it is least expected. One cannot give too loud praise to this form of united effort, nor be too ready to render assistance to those whose duty and work it is to care for or improve the health of the public. This, indeed, is one method, a most successful one, scarcely of caring for the patient but of obviating care; which, after all, is the most effective way of practicing medicine.

THE BENEFITS AND DANGERS OF MEDICAL SPECIALIZATION

In spite of this courageous and successful fight to reduce mortality and illness, disease persists in one form or another and will continue to do so. We must, therefore, render aid to the individual as constantly and with as much solicitude as ever. The ways and means by which this can best be done are problems that have occupied much thought. How can the greatest benefit be brought to the largest number? Scientific research has led to the accumulation of vast numbers of facts, and developed innumerable methods that may be applied in the practice of medicine for the diagnosis and treatment of disease. We are richly supplied with means for acquiring information about the physical, chemical and immunological changes that take place in the human body during the course of disease; while we are daily adding new knowledge and better methods to chemical and physical therapeutics. It inevitably follows that the technical skill and specialized training, required to use these measures successfully in the diagnosis and treatment of disease, assume positions of more and more importance, until the point is reached where specialists and experts are developing in ever increasing numbers. We must admit the fact, that one conscientious physician cannot, today, hope to employ all or, indeed, most of these useful methods with justice or even safety to his patients. There must be some division of labor. This, indeed, has long since taken place, and now bids fair to reach the stage where there is actual danger that the division and subdivision of labor will lead the medical profession to the very efficient but inapplicable system of the Ford factory; where each expert performs his daily task with sure precision and dexterity, but with responsibility for his particular job and nothing more.

As an outgrowth of such specialization, two general methods have been devised to meet the needs of the situation. In one of these physicians, surgeons and specialists have combined in a unit or group to attack, from all angles, the disease from which the patient suffers; in the other system patients, suffering from the same malady, are segregated so that they may be cared for by doctors whose experience and training fits them particularly for these special duties. More recently, there has been a tendency to carry the latter form of organization to a point that seems somewhat fantastic. The dissection, as it were, of illness, or of the patient himself, proceeds to almost unrestricted bounds. Within the confines of internal medicine itself we

have services in hospitals or doctors' offices for diabetes, for heart disease, for disorders of the alimentary tract, for Brights' disease, for hypertension, for exophthalmic goiter, for asthma and hay fever, and so on until we run the risk of complicating the situation unmercifully for the patient, and of being in an absurd position of treating each separate disease, or each individual organ, in an isolated department.

We should be cautious lest adherence to a system, rather than to an idea, result in fruitless effort. For it must be remembered that these devices are but methods and systems, susceptible of being used to advantage when employed to attain a worthy end, but equally susceptible of being turned into an abomination when worshipped for themselves. Their worth or worthlessness depends entirely on the end to which they are put. When the plan of segregating patients for study and treatment is adopted deliberately and temporarily, for a particular clinical research, or to facilitate a special form of treatment, it has great value, and may be pursued with advantage both to the patient and to medicine in general, but when it is followed blindly, as a routine, it becomes usually disastrous both to the physician and to the patient, for the physician, too frequently, sinks to the level of a technician, while the patient shrivels to a mere shell encasing a great liver or other single organ.

On the other hand, to illustrate the benefits that may be derived from this method of work, I need only call attention to one field in which the plan of segregation, combined with concentrated study, has well served a dominating purpose. This is in the war against tuberculosis. The success attained in this fight is largely attributable to a systematic and well organized effort to direct many forms of activity against this single problem. Detection of tuberculosis in its incipient stage, education of the public, the institution of modern methods of treatment in sanatoriums and the prevention of spread by contact are among the most effective measures that have been employed in this successful campaign. It required an army of devoted workers, who have accomplished a magnificent piece of work. An organization is now well under way to tackle, in a somewhat similar manner, the very difficult problem of heart disease; and if some day such methods could be employed against syphilis they would, no doubt, go far toward actually eliminating this disease. An instance of the successful application of this plan of operation, which has been practically completed, is to be found in the work on diabetes. Now that the

diagnosis and methods of treatment have been so thoroughly established, and have proven to be so brilliantly successful, the special diabetic clinic becomes largely a technical affair, since the proper balancing of diet and the administration of insulin can be accomplished successfully by any well trained physician. The special diabetic clinic, therefore, has served its end, and, except for economy of time and materials, there is no longer need to segregate these patients.

I cannot refrain from emphasizing again the danger of laying too great stress on method, organization and system. These are but means to be employed intelligently, deftly and with precision. As pieces of machinery, working smoothly and efficiently to accomplish a fine purpose, they are to be admired; but intrinsically they have no value in themselves. There was a very pertinent discussion on methods and ideas in an editorial in a recent issue of the Journal of the American Medical Association, and I may be pardoned for repeating once again the quotation from Claude Bernard, who says in his *Introduction à l'étude de la médecine expérimentale,*

> The experimental method cannot give new and fruitful ideas to men who have none; it can serve only to guide the ideas of men who have them, to direct their ideas and to develop them so as to get the best possible results . . . As only what has been sown in the ground will even grow in it, so nothing will be developed by the experimental method except the ideas submitted to it. The method itself gives birth to nothing. Certain philosophers have made the mistake of according too much power to method along these lines.

When technic itself comes to have a fatal fascination, then mental and manual dexterity outweigh, or actually replace, the idea. There is some justice in the criticism that, at times, we have been more interested in methods than in man; there can be no grounds for the statement that scientific investigation is responsible for this attitude. From the time of Hippocrates, medicine has always reached its highest levels when the study of the natural phenomena of disease was in the ascendant. At such times, methods have often been of the simplest variety; but observations have been made precisely and with astounding accuracy, while reasoning has been remarkably direct and sound. It is only when we subjugate our main objects, the protection of human beings from disease, (commonly called the prevention of disease), and the restitution of the sick man to health, (commonly called the cure of disease), to methods and technic that we degenerate. Aside from this error of worshipping the means, we sometimes, I am sure, confuse the province of pathology with that of clinical medicine.

Pathology concerns itself with the study, investigation and interpretation of disease processes, while clinical medicine deals with disease in man and its elucidation by all available methods.

DISEASE AS A REACTIVE PROCESS

And, now, we come to the crux of the whole matter. As doctors our thoughts and energy are concentrated on the abnormalities of human beings. There is no separation of man from his disease or of disease from man. The two are part and parcel of a single unit which needs some further definition for our purposes. What we recognize and classify as a disease picture is, in reality, the kaleidoscopic reactions of a man to some injury. This injury may take the form of invasion of the body by bacteria, the disturbance of the specific function of some organ (diabetes, Graves' disease), or a mechanical defect such as occurs in heart disease. In any event it is the patient, not the typhoid bacillus, that presents to us the disease called typhoid; it is the violently disturbed reaction of the patient to the abnormal action of the thyroid gland, not thyroxin, that gives us Graves' disease, and it is the more or less successful efforts of the patient to overcome a stricture of the mitral orifice, not the stenosis itself, that produces the picture called heart disease.

This conception of disease as a reactive process is not new. Indeed it is as old as medicine itself, as pointed out by Dr. Welch about thirty years ago in an address on *Adaptation in Pathologic Processes.* In developing this subject he says:

> I cannot refrain, however, from merely referring to the important rôle which the conception of disease, as in some way conservative or combative in the presence of harmful influences, has played from ancient times to the present in the history of medical doctrines. Whole systems have been founded upon this conception clothed in varying garb. There is nothing new even in the image, so popular nowadays, representing certain morbid processes as a struggle on the part of forces within the body against the attacks of harmful agents from the outer world. Indeed Stahl's whole conception of disease was that it represented such a struggle between the anima and noxious agent.

In the field of general medicine, in which we come more and more to think of morbid processes in terms of etiology, we have been prone to connect the morbid process with the parasite, the injury or the deformity itself rather than with the host. Without the host, however, there can be no disease. In the general field of mental disorders, on the other hand, it is quite usual for us to conceive of the morbid

process as an actual change in personality. Here the person stands paramount, the individual himself becomes the paretic or melancholic. It would sound strange, perhaps, to speak of a man suffering from pneumonia as a pneumonic, though we are accustomed to say of this or that patient that he is a diebetic or a syphilitic. The implication is that the person himself is altered, and that the illness becomes a part of his physical existence. This idea of disease, or illness, as forming a new physical characteristic of the person is not difficult to understand.

THE MENTAL CONDITION OF THE PATIENT AS A PART OF THE DISEASE STATE

But the conception of disease, solely as a new physical state of being in the particular person, is still incomplete, for one essential feature of this state is mental. The intellectual, the emotional, the spiritual qualities of the patient form an integral part of this disease state. When one speaks of the interaction between parasite and host, one must conceive of the host as a living, thinking physical being controlled by appetites, hopes, fears, beliefs and passions. As many modern philosophers and behaviorists insist, the body and mind are inseparable, although the idea of the body as one entity and the mind as another has existed for such ages, and is so deeply rooted that we have no word, as John Dewey says, to express this "wholeness of operation" or "unity in action." In a recent address before the Academy of Medicine in New York, John Dewey said:

> There exists in present society, especially in industry, a large amount of activity that is almost exclusively mechanical; that is carried on with a minimum of thought and of accompanying emotion. There is a large amount of activity especially in "Intellectual" and "religious" groups in which the physical factor is at a minimum and what little there is is regretted as a deplorable necessity. But either sort of behavior in the degree of its one sidedness marks a degradation, an acquired habit whose formation is due to undesirable conditions; each marks an approximation to the pathological, a departure from that wholeness which is health.

This quotation is quite as applicable to the physician as to the patient.

I have made some effort to present disease as an active process, incorporating in its entity both the physical and the mental forces of the patient. Its purpose is directed to the restoration or approximation of the wholeness of health, by destruction of the invading parasite, through satisfactory readjustment to a permanent injury,

or by temporary accommodation to a physiological disturbance. Each individual attacks his problem, both consciously and unconsciously, in a different manner; and, though the common problems, themselves, are fairly limited in number and more or less familiar to us, each patient's method of attack or of resistance, which we call the disease picture, is marvelously and infinitely varied. This matter of attack or of resistance depends on a multitude of factors; race, inheritance, age, environment, experience, education all come into play; and as these factors work to differentiate one person from another, so they tend to individualize disease in each single patient. The intricate combinations in any man of anatomical, physiological, immunological and psychological attributes, so aptly termed by Draper the "panels of personality," together form the fertile, indifferent or resistant soil on which the noxious germ is sown or injury done. The disease picture, the pathological state, depends on the manner in which these forces overcome this noxious agent, resist it, or sink before the fatal injury.

To illustrate the point, we may consider two or three examples. The first should be an infection, and for simplicity's sake we will select that produced by Bacillus typhosus. The body of the young child is relatively resistant to this infection, and even though the germ gains entrance to the body, it may not find a soil favorable for growth. The less resistant may become infected, but the disease, as we say, is mild. The tissues overcome the germ, and neutralize its poison with comparatively little effort; the mind, less complicated in its mechanism than that of the adult, rests peacefully, and lets the tissues do their work successfully. In early adult life, and during pubescence, the body, for some reason, is more vulnerable, the reaction of the tissues more florid, and the psychic disturbances more violent; all of these transform the patient into a disease state that is called severe, dangerous, critical or hopeless. Finally, in old age, the body again becomes resistant, either from acquired immunity or from loss of favorable conditions for the growth of typhoid bacilli. The fire of youth has gone and if, by some peculiar chance, the body is invaded, the reaction of the tissues is sluggish and the temperature is low, but the mind, half clouded, wanders incessantly, subconsciously in delirium exposing the accumulation of years' experiences. In the three disease pictures, the morbid state would vary in the same person, if such a thing were possible, according to age, physical growth, experience and education.

As another example, one might select diabetes mellitus, primarily a disturbance in the function of a vital organ. Comparatively uncommon in the negro; said to be most common in the Jewish race; notoriously severe in children; strikingly mild in old age; influenced in many patients by their previous habits of eating, and the ease with which they put on weight; producing a craving for food that undermines the moral character; leading to neuritis in some older subjects; interfering with the natural growth and maturation of the youthful, the morbid state of diabetes mellitus assumes an individuality for each and every patient.

Just as no two human beings are precisely alike, not even twins from the same ovum, so two disease states can never be identical, even though they are produced by almost indistinguishable agents. Similarities do exist between disease states as well as between human beings. This is most noticeable in twins, quite common in families, not rare in communities, unusual between nations and most divergent in different races. A single anatomical feature, too, a peculiar mode of thought, a simple physiological process or an isolated pathological lesion may seem to be exactly the same in two different individuals; but each complete personality, each state of disease, is unique.

When disease is regarded from this point of view, the slightest departure from the wholeness of health may produce a profound and lasting effect; for the significance of the injury may depend, not so much on its physical result, as on the interpretation that the patient gives it. A mild attack of vomiting may lead to years of misery, since the patient may regard it as an early sign of cancer; or a fleeting pain across the chest may breed the fear of heart disease which remains persistently for months. I once knew a woman who, when on her way home from Samoa, discovered a skin eruption on one hand. She was convinced that she had leprosy. When she arrived in this country the blemish had disappeared and its nature was never known. Though assured by her physicians that she was physically sound, she lived for years to all intents and purposes a leper.

THE MENTAL CONDITION OF THE PATIENT AS A FACTOR IN TREATMENT

One begins to understand, now, how the care of the patient depends on a knowledge of the wholeness of the patient; how without this knowledge one gropes in the dark, sometimes inflicting wounds, and,

in an effort to cure symptoms, leaving bruises worse than the malady itself. Indeed, most symptoms, as you know, are dependent solely on some interference or perversion of a physiological process; and though in many instances an anatomical lesion is responsible for the perversion of function, this is not always true. One vomits, for instance, at a sickening sight as well as in cancer of the stomach. Tachycardia and palpitation are frequently referable to some psychic disturbance, while excitement and anger increase the blood pressure, and emotional conflicts cause a sense of great fatigue. Such abnormal sensations, in order to become symptoms, must first come into the field of consciousness; and consequently symptoms are in simple terms but part and parcel of the patient's cerebration. On the acuteness of this cerebration, furthermore, depend very largely the number and severity of the symptoms.

If the patient confined himself exclusively to accurate observation and precise description of his symptoms, our work would be much simplified; but for most patients this does not suffice. They forever seek an explanation for their sensations, and attribute their malaise or pains to indigestion, to some trouble with the heart, to cancer, or try at least to tag their symptoms with the familiar name of some disease. The one explanation that they shun most vigorously is the so-called nervous origin of their symptoms. They search invariably and continuously for a purely physical basis.

It is not my intention to discuss the purely emotional disturbances, the psychoneuroses; but before speaking of organic disease, as complicated by such factors, it would be useful to refer to one example, which illustrates the fact that functional derangements of mind may masquerade as well defined diseases of somatic origin.

It is not uncommon to see, from time to time, a poor fellow relegated to chronic invalidism on account of symptoms, due entirely to the perverted function of some organ, and yet originating in emotional disturbance. When the symptoms are indicative of a serious disorder and are combined with signs suggestive of actual disease of the organ, the solution of the problem becomes doubly difficult. Under happy circumstances, however, the cure of such an illness may sometimes be accomplished in a single conversation. I recall very well seeing a young man, several years ago, who had been kept flat in bed for six months on account of symptoms simulating heart disease. He had had severe palpitation, tachycardia and fainting attacks; and his physicians, hearing a systolic murmur over the

precordium, had told him that he had serious heart trouble, and a limited number of years to live. A careful examination did not convince me that he had any actual disease of the heart, and in conversation, the patient, who was an intelligent man, insisted that he knew his heart was sound. The story of the onset of his symptoms revealed their origin. He had just been elevated to an important position in a bank, when, one morning, he found that the accounts of one of his assistants, who was also a friend and who was absent that day, had been falsified, and that the assistant had absconded with a large sum of money. Greatly perturbed, he went out to lunch, and as he rose from the table to leave the restaurant he came face to face with a detective. Instantly, he had a violent attack of palpitation, and fainted outside the door of the restaurant. During the ensuing investigation there were repetitions of these attacks, and, when his name was finally cleared and he was freed of all blame, he became so miserable that he sought medical advice with the result already told you. He had never before spoken, of the incident in the restaurant or of his momentary terror. Fortunately, the solution of his problem was a simple one. It required only an explanation of his misinterpretations and reassurance. He threw away his digitalis, went to work, played golf and tennis and has been in excellent health ever since.

Often the busy doctor feels he has no time to spend long hours in conversation with a patient, but occasionally such an interview might obviate much suffering, as well as many visits to the office or to the patient's home.

If such serious symptoms may arise solely from emotional disturbances, consider, for an instant, the deplorable plight of the poor fellow who has to wrestle, not only with an organic disease, but with his emotions as well. For, I suppose, it is fair to say that no patient suffering from an organic disease, unless his mind be clouded, is free from more or less emotional strain. Whether this depends on the readjustments, made necessary by his actual state of illness, or whether it depends on a misinterpretation or improper estimate of symptoms, the emotional strain becomes an actual part of the disease, and has a definite bearing on its course.

There is one question that I rarely fail to ask a patient and that is "What do you think is the matter with you?" Occasionally the answer comes immediately "Is it anything like cancer, Doctor?" or "I thought I might have some trouble with my heart." More

often the question is evaded, and a secret fear of which the patient may actually be ashamed guarded more closely; yet with perseverence one may finally extract an embarrassed reply. Some of these fears and anxieties are well founded, others, are preposterous and based on misinterpretations; but under any circumstances they must be taken seriously. When the doctor can truthfully dispel this fear, and it may require long and careful examinations and detailed explanations to do so, he has rendered that patient a great service and perhaps even cured him of his symptoms.

In large part this emotional reaction is dependent on the nature of the patient. The introvert, or more especially the timid person, is prone to exaggerate each sensation and to give it undue importance; or to misinterpret the significance of symptoms and use them for some selfish purpose. The extroverts may have a nobler attitude. They disregard their symptoms, discountenance the importance of their illness, continue to perform their duties and interfere deplorably with the somatic efforts of adaptation to the injury. The course and picture of disease is thus affected and modified in a thousand different ways by the mental attitude of the patient. Our efforts to relieve suffering must be directed to both mind and body, and to the "wholeness" of the individual, where intellectual and emotional processes often need more attention than the physical.

By way of illustration one could mention many trite examples. One is the man of business, suffering from angina pectoris, and worried about business, family and sudden death. The actual knowledge of this distress cannot but stare us in the face, but we have scarcely performed our duty as doctors if we simply recognize and accept this complication without making serious effort to correct it; an essential form of therapy which is far more difficult, and possibly more efficacious, than prescribing rest and nitroglycerine. The patient with high blood pressure presents a somewhat similar and quite familiar problem. In such instances there is soon established a vicious circle. The hypertension not infrequently increases the nervous reaction, while the emotional unbalance sends the blood pressure mounting to a higher level. It is often a difficult matter to cut through this vicious circle. One searches tediously for a flaw in the ring. I can remember one instance, in which it was necessary to persuade a rich and elderly husband to turn over a small fortune to his wife, who hitherto had been financially dependent on him, before the anxiety attending her persistent hypertension was satisfactorily relieved. Such examples could

be modified ad infinitum, and although the emotional factor is particularly common and familiar in such varieties of illness as I have mentioned, it plays a more or less important part in every sickness. One often hears it said that the "good" patient does well, by which, I suppose, is meant that the truly unemotional placid type of individual gives nature her best chance.

MENTAL PROBLEMS OF CHRONIC DISEASE

Though each patient presents some such problem of either minor or major importance, the most serious situations arise, most naturally, in those afflicted with chronic disease. The impatience and irritation that any patient with heart disease may feel against a restraint, too rigidly enforced, often results in a physical agitation that may do more harm than intelligently graded exercises, with properly limited physical activity. This is especially true of the aged; and, when a cure is impossible, it is the duty of the physician to bring contentment, comfort or even happiness to his patients to lighten the burden of their affliction. But this does not mean necessarily that he should limit living to prolong life. As I grow older, I have less and less sympathy with the conscientious efforts merely to extend life in old age. The curtailment of activities, the tender nursing, the humane and assiduous attention of doctors is apt, too frequently, to carry the aged tottering by the danger point, and leave them helpless doddering wrecks of humanity. Having arrived at this stage, it seems beyond their power, or desire, to let go the one thing they possess, that shred of life that ties them uselessly to earth. The philosophy of Stevenson's *Aes Triplex* suites me better. He says "We do not, properly speaking, love life but living." and again, "Does not life go down with better grace, foaming in full body over a precipice, than miserably straggling to an end in sandy deltas?" It is the duty of the doctor to preserve, not only health and life, but joy of living; and if most of us had to make our choice we would take the latter. Why ward off death, if in the attempt we kill living? But these, perhaps, are matters over which we have but slight control. The vigorously minded patient knows the hounds are in pursuit, and keeps up the chase in spite of our earnest protests and our pleadings to seek shelter.

It is not only in the chronic invalid, or in those fatally diseased, that the patient needs more care than the disease needs treatment. Even the acutely ill present problems for solution. Over and over

again the convalescence from an acute illness is prolonged, or the health of the patient actually endangered through complications, because of his impatience to return to work. A simple investigation soon shows that it is not the work he wants but money to pay his hospital expenses or the debts incurred by his family during his illness. Once these worries are relieved recovery promptly follows.

Indeed, the management of convalescence is worthy of a treatise in itself. As far as the friends, family and doctor are concerned, the illness has passed; the patient, though perhaps weak, is physically sound, and thus is heartily congratulated on his satisfactory and miraculous recovery and dismissed by all hands with rejoicing. The poor patient, on the other hand, now acutely aware of every disagreeable sensation, weary or exhausted in mind and body, unconsciously exaggerates these sensations, misinterprets his symptoms, undergoes agonies of fear lest he should never recover, or imagines he is left with some incurable result or that his illness is about to recur. Too tired to comprehend the logical reasoning of his friends and doctor, he drags on a miserable existence; until suddenly to his utter astonishment he does recover. It has often seemed to me that this period of profound unhappiness might be considerably shortened by proper reeducation of the mind as well as of the muscles of the body.

ALTERATIONS OF PERSONALITY IN DISEASE

In some conditions, there is a more subtle and profound disturbance of the mentality, that must be dealt with as an integral part of the disease, rather than as a natural quality of the patient. Aside from the actual psychoses, and the emotional disturbances attending almost any illness, one frequently observes slight alterations in personality, assuming so frequently the same form in each particular disease, that one comes to connect these mental aberrations with particular varieties of illness. To illustrate, I may mention one or two examples: Any patient suffering from pernicious anemia may, during the exacerbation of his disease, become querulous, irritable and in general terms extremely disagreeable. But as far as one can tell this is no fault of his, and he has no more control over his mental state than he has over his blood count. Nurses and doctors are sometimes prone to overlook this fact, and thus subject such patients to disciplinary measures that only make them worse. With recovery, however, many of these patients prove to be as sweet tempered as you please, and then the

nurse and doctor pride themselves on the excellent effect of their discipline. Another example is the peculiar delirium of typhoid.

Enough has been said to make clear that no study of disease, no therapeutic measure, can be undertaken without due regard to the personality of the patient. In almost every instance his mental make-up influences, in some way, the clinical course of the disease, while minute consideration of his character is often imperative if one wants to institute and carry forward successful therapeutic measures. On the other hand, one must recognize the fact that minor alterations in personality may be actually a symptom of the disease itself; and over these the poor sufferer has but slight control. One must regard them in the same light as edema of the feet in heart disease, or loss of weight in diabetes mellitus.

THE RELATION BETWEEN DOCTOR AND PATIENT

Perhaps you think, as students, that you have not time or opportunity to devote yourselves to patients in this particular manner and with such elaboration of detail. The hours are short, the desire to become acquainted with a multitude of pathological lesions in the human subject is great, and the routine of the dispensary or ward affords few occasions for conversations with patients.

Not only in institutions, but in the office of the busy modern practitioner, an efficient routine, too often, supplants or at least discourages the personal recognition that the patient needs and craves. The situation recalls a story, as I remember told by Kipling. A murderer, who got off with a life sentence, when asked what had impressed him most at the trial, replied that it was the frank boredom of all who took part in the trial. "You come to 'em," he said, "full of your affairs and then find it's only part of their daily work to them." How frequently might patients think the same: One patient comes rushing impetuously to the office or hospital, bent on having the thing over with immediately, and ready, at any cost, to get at the bottom of his complaint; another, after days of indecision, finally screws up his courage to the point of entering timorously the doctor's office or the dispensary, terrified lest his worst fears be realized at this fateful visit. Under any circumstances, each patient considers his complaint as one of great peculiarity or perhaps obscurity, demanding prompt attention. When clerks and secretaries regard the situation as commonplace it is bad enough; but if the doctor, fagged perhaps by a

hard day's work, does not show a spark of sympathy or understanding, the visit becomes a flat failure, and, for all the good most patients get, they might as well use a penny slot machine.

The effect of this mechanical routine on the patient is most noticeable in institutions. Many of you have already discovered that some patients try to hide, or actually seem to lose, their identity in the overwhelming system of a hospital. They shrink from disclosing themselves as individuals. They may resort to fictitious names or give false addresses. But, as a matter of fact, it is usually not difficult for the doctor to penetrate this disguise. Most patients long for some one to whom they can confide their troubles. For this they look to the doctor, and it makes little difference whether he is clerk, intern, or professor so long as he is the right sort. It may only be necessary for students to have recourse to a simple conversation; to show real interest in this man or that woman, as an individual, in order to let loose a flood of startling confidences. At other times the way is not so clear, suspicions and fears must be allayed before the friendly relations can be established. And then there comes, little by little, or sometimes in torrents, a more or less disjointed story, which, when pieced together, gives the record of a human life surprisingly valuable, at times, in disclosing an explanation for the actual physical ailment. You thus increase your knowledge of human nature, often learn a way to help the patient in his distress, and in addition gain a friend.

Pope has said that the "proper study of mankind is man," and there is no wider or more fertile field for such study than the dispensaries and wards of a hospital. At bottom, we all have many qualities in common, and these fundamental properties can be observed with somewhat less effort on our part in the clientele of a hospital, than in those members of society who are more deeply imbued with the "herd instinct," as Trotter calls it, or are protected by inherited conventionalities of thought and conduct. If we turn our attention, for an instant, from the study of the abnormal organ or pathology, to the study of the morbid patient, the scope of clinical medicine widens, and takes on a character that differentiates it from all other arts and sciences.

The study of the patient, however, which is preliminary to his proper care, must of necessity be prosecuted in a special manner. The relationship between doctor and patient partakes of a peculiar intimacy. It presupposes on the part of the physician not only knowledge of his fellow men but sympathy. He sits, not as a judge

of morals and of conduct, but rather as an impersonal repository for confession. The patient, on his part, must feel the need of aid, and few patients come to doctors except with this incentive. This aspect of the practice of medicine has been designated as the art; yet I wonder whether it should not, most properly, be called the essence.

How to teach it to you students, however, is a problem. One can teach methods, impart information, convey a point of view and stimulate to growth those qualities inherent in the student; but to instill this essence, itself, there is no form or precept that I know of. The very nature of the thing forbids it. An effort can be made by the instructors of medicine to practice, before the student, in both hospital ward and dispensary; but as a rule the teacher, as he makes his visit in the ward with clerks and house staff, must direct his whole attention to his pupils, in order to expound to them the diagnosis and the treatment of the organic lesions which form the origin of that patient's illness. He may, even under these circumstances, manage to impress them with the fact that the actual physical disease is primarily a reaction to these lesions. In his rôle of physician, however, he must deliberately forget his pupils, turn his back on them, direct his whole attention to the patient and become, exclusively and intently, absorbed in him. This is, at best, a trying situation both for patient and pupil; while, between the two, the poor teacher has a bad time of it. Nevertheless it is only by such means, difficult as they are, that one can practice medicine before students. Those pupils sensitive to human suffering and interested in mankind, may profit eventually by such examples; but others craving information, attracted more by abstract problems and practical methods than by a study of human nature, are often frankly bored by such proceedings.

My last remarks about instruction must be taken, in part, as an extenuation of the shortcomings of this lecture, for one cannot use rules or formulae in caring for a patient. Each patient is a suffering, sensitive, thinking disease personality, not simply a sack of abnormal organs; each patient has his own peculiar problem to be solved. Undue concentration either on the physical defects, on the one hand, or on the emotional conflict, on the other leads us inevitably to a degraded point of view. It is only when we understand the unity of patient and his illness that we can hope to cure successfully, relieve suffering or bring consolation to the sick.

GROWTH CHANGES IN PHYSICAL CORRELATION—HEIGHT, WEIGHT, AND CHEST-CIRCUMFERENCE MALES*

BY JOSEPH BERKSON

This research is submitted as a contribution to our knowledge of the physical age changes that we know as growth. Such changes embrace every aspect of ontogeny, and attention may be focused on the anatomical or physiological with equal relevancy. There is, however, a field of inquiry within the general domain of physical growth, which is confined to neither form nor function but refers in a measure to both, and concerns the forces that assemble the elements of morphology for integration in the individual. It is a truism that one part of the body is coordinated with another during every phase of development. The pathological deviations from such coordination that have been revealed in the study of endocrinology serve only to emphasize the elaborate correlation that is a constant force in the normal organism. But the physiologic influences represented in the several ductless glands must be only a part of a broader correlation that includes these organs themselves. From the point of view of the organism taken as a whole, the detailed mechanisms are incidental to an all-pervading inter-dependence of one structure and another. Further, it is to be supposed that these inter-dependencies are not indifferent, in respect of kind or degree, to the aging process. From what we know of the alternate stimulus and retardation exhibited during growth, especially in the period from birth to maturity, it is to be suspected that the growth function in other of its details reflects such changing characters. In the following study, I propose to test this conjecture in regard to the interrelationship of three morphologic variables in the male, height, weight and chest-circumference.

The method used is biometric. As a measure of relationship, I shall use the Pearsonian product-moment coefficient r. Applied to two variables, x and y this statistic (designated r_{xy}) measures the degree

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to which the two variables are found associated. If they are quite independent, so that any value of one is found with a particular value of the other only by chance, the measure of r will be zero. If, on the other hand, any particular value of one variable is found always associated with some special value of the other, the correlation will be unity. Between these two extremes are the cases in which, because one variable partly determines the other, or because both are dependent in some degree upon common determinative factors, one variable partly fixes the value of the other. In such instances r will be intermediate in value, approaching unity the greater the degree of association.*

To my knowledge no previous attempt has been made to investigate interrelationships by this method over the entire age range, for any human characters whatever. In this connection, however, certain other studies, directed primarily at different problems, have evaluated several of the pertinent correlations for consecutive ages. Of these a certain number are to be considered valuable for comparison with my own results and a review of them is therefore presented.

Boas and Wissler ① 1904 analyzed a series of measurements of individuals in Worcester, Massachusetts. Stature was measured standing free, by means of a rod with a sliding arm, weight with clothing but without shoes. The correlations between stature and weight as given by the authors follow.

TABLE 1

Boas and Wissler Height and Weight

AGE *Yrs.*	CORRELATION HEIGHT AND WEIGHT	NUMBER IN SAMPLE	AGE *Yrs.*	CORRELATION HEIGHT AND WEIGHT	NUMBER IN SAMPLE
6	.86	109	12	.81	246
7	.78	202	13	.74	214
8	.69	190	14	.87	203
9	.72	220	15	.81	162
10	.83	221	16	.71	93
11	.88	208	17	.56	39

E. Schuster ② 1910 analyzed a series of measurements made on Oxford undergraduates. Height was measured in centimeters with the subjects in stocking feet, and weight in pounds with clothes but

* If one variable increases with an increase of the other, r is plus, if it decreases it is negative in sign.

without shoes. The results of the correlation determinations and the means of the characters concerned were as follows:

TABLE 2
Schuster Height and Weight

AGE *Yrs.*	MEAN		r	NUMBER
	Height	Weight		
18	175.76 ± .34	147.56 ± .87	.50 ± .04	129
19	176.72 ± .25	152.06 ± .62	.63 ± .02	330
20	176.62 ± .32	151.56 ± .75	.68 ± .03	209
21	177.86 ± .41	156.06 ± 1.00	.76 ± .02	137
22	175.75 ± .46	152.62 ± 1.19	.72 ± .03	95
23+	176.9 ± .62	151.75 ± 1.37	.....	59

B. T. Baldwin ③ 1921, analyzed the measurements of a group of students of the Horace Mann School, Teachers' College, Columbia. He says in describing the data:

"The original measurements were made on nude children, who, for several years had been subjected to school medical inspection, physical training, and directed play. The number of children could have been increased by including those deviating from a normal type, but this seemed undesirable."

The results of the correlation determination for males are as follows:

TABLE 3
Baldwin Correlations

AGE *Yrs.*	r			NUMBER
	Height-Weight	Height-Chest circumference	Weight-Chest circumference	
7	.872 ± .035	.716 ± .070	.888 ± .030	about
8	.850 ± .030	.595 ± .069	.832 ± .033	60
9	.876 ± .022	.685 ± .051	.793 ± .036	in
10	.856 ± .024	.721 ± .043	.826 ± .028	each
11	.853 ± .022	.676 ± .043	.888 ± .017	group
12	.782 ± .030	.612 ± .048	.879 ± .018	
13	.790 ± .029	.559 ± .054	.865 ± .020	
14	.877 ± .019	.756 ± .035	.897 ± .016	
15	.797 ± .031	.698 ± .044	.887 ± .018	
16	.668 ± .056	.630 ± .061	.823 ± .033	
17	.680 ± .055	.556 ± .071	.872 ± .025	
Av.....	.809		.859	

Concerning these the author comments:

The relation between yearly measurements of growth in height and weight for boys is relatively uniform from seven to eleven years. The coefficient reaches a maximum at fourteen years. The coefficent is at a minimum at sixteen years.

The coefficients of correlation between the yearly measurements of height and girth of chest are lower than the coefficients between height and weight. The coefficients between height and girth of chest drop from + .716 at seven years to + .595 at eight years, increase to + .721 at ten years, drop to + .559 at thirteen years, increase to + .756 at fourteen years, and then gradually decrease to + .556 at seventeen years.

Between the yearly measurements of weight and girth of chest, the correlations are higher than between weight and any other physical trait measured. The coefficients are fairly uniform throughout the ten years, varying from .793 at nine years to .897 at fourteen.

Mumford and Young ④ 1923, analyzed the measurements of a group of boys at the Manchester Grammar School. Weights were obtained in ordinary gymnasium costume. The correlations of interest here that were determined are as follows:

TABLE 4
Mumford and Young Correlations

AGE *Yrs.*	r			NUMBER
	Height-Weight	Height-Chest circumference	Weight-Chest circumference	
11	.789 ± .047	.225 ± .119	.701 ± .064	29
12	.748 ± .028	.652 ± .037	.881 ± .014	112
13	.788 ± .019	.670 ± .028	.855 ± .013	173
14	.774 ± .017	.651 ± .024	.877 ± .010	255
15	.823 ± .013	.688 ± .022	.891 ± .009	263
16	.812 ± .017	.651 ± .030	.868 ± .013	173
17	.704 ± .038	.507 ± .056	.840 ± .022	80
18	.784 ± .052	.373 ± .116	.780 ± .053	25

Concerning these figures the authors comment:

The coefficients between any two variables seem to show definite, if not significant, differences at the several ages. This is marked, even when the coefficients for ages eleven and eighteen are excluded, owing to the paucity of the observations on which they are based. While there is no very definite evidence that they vary at the different ages in any special or characteristic manner, it seems more than a coincidence that with one or two exceptions, the highest values are attained at ages thirteen and fifteen.

Paton and Findlay ⑤ 1926, analyzed the measurements made among the poorer classes in Dundee, Glasgow and Edinburgh. Pertinent correlations are given for different groups separately by age as follows:

TABLE 5

Paton and Findlay Correlation between Height and Weight

AGE	GLASGOW	EDIN-BURGH	DUNDEE	RURAL MINERS	AGRICUL-TURAL LABORERS
3 months	.....	.75 ± .06	.64 ± .04	.79 ± .03	.74 ± .04
3 months +	.....	.14 ± .11	.76 ± .03	.45 ± .06	.53 ± .06
6 months +	.....	.35 ± .10	.62 ± .05	.39 ± .06	.55 ± .06
9 months +	.....	.68 ± .06	.62 ± .05	.62 ± .05	.49 ± .07
1 + years	.45 ± .05	.72 ± .03	.68 ± .03	.72 ± .02	.65 ± .02
2 + years	.57 ± .04	.55 ± .04	.69 ± .03	.67 ± .02	.59 ± .03
3 + years	.60 ± .04	.58 ± .04	.74 ± .03	.62 ± .02	.60 ± .03
4 + years	.61 ± .04	.40 ± .06	.70 ± .03	.45 ± .03	.53 ± .04
5 + years	.62 ± .04	.63 ± .05	.66 ± .04	.48 ± .04	.57 ± .04

THE PRESENT INVESTIGATION

DATA

It was found impossible to procure a single sample for the entire range of life, containing a sufficiently large number of individuals and giving the required measurements of height, weight and chest-circumference. In lieu of such a sample several groups were secured, each giving a portion of the desired data as follows:

Sample I. Woodbury's Study of Statures and Weights of Children Under Six Years

The statistics of some 80,000 measurements of height and weight of male white children in the age range 0–7 years tabulated by Woodbury ⑥ were utilized for the determination of correlation coefficients between height and weight in this age range. The children were of various stock, from different states of the United States and without physical defect that might affect stature or weight. They were measured and weighed without clothing in inches and pounds.

For a more detailed description of the data, the original publication by the Department of Labor may be consulted.

In order to determine the correlations specifically for the several ages, regression lines were fitted by least squares, for the data at each age, to the mean weights for fixed heights, and from these the correlation coefficients calculated as explained in the Appendix I.

Sample II. United States Public Health Survey

Records of height, weight and chest circumference measurements from a large series, made in the course of a national health survey by the United States Public Health Service and reported by S. D. Collins and T. Clark (7) of that Bureau, were lent to me for this study.

The measurements were made as follows: Height was measured without shoes to the nearest quarter inch. Weight was recorded without shoes or heavy clothing to the nearest quarter pound. Chest-circumference was measured with the subject breathing quietly, at the line of the nipples, over the skin or light garment, to the nearest quarter inch.

In the case of all three measurements, I used a grouping for calculations broader than that given by the original records, but fine enough not to affect significantly the statistical results.

The group contained males of the ages of seven through sixteen years, of native parentage and grand-parentage, without any physical defect, and described as in good or excellent nutrition. The data utilized for this study are not identical with similar ones used in the studies of the United States Public Health Service, in that the present ones are limited to the individuals for whom all three pertinent measures concerned were known.

Sample III. United States Public Health Service Posture Study

Height, weight and chest circumference measurements from a series made by the United States Public Health Service, for a posture study published by L. Schwartz, R. Britton, and L. Thompson (8) of that Service, were lent to me for this investigation.

Individuals were measured as follows: Height—in bare feet, in inches; Weight—in pounds, the subject nude; Chest-circumference—measured over the bare skin at the level of the nipple, an average of the inspiration and expiration measured in centimeters.

The individuals used were six years or over, of native parentage, and without gross physical defect. The children came mostly from New York public schools, the adults from Y.M.C.A's. The group of measurements used here is not exactly that used in the original study, being more limited here in age range and comprising only

individuals for whom all pertinent measures were available. Grouping in the case of all three measures was broader than in the original records, but refined enough to give substantially the same statistical results.

Sample IV. University of Minnesota Students

Records used for investigation of the physique of male students of the University of Minnesota by C. M. Jackson (9) and reported by him were lent to me for this study.

The individuals used ranged in age from 17 years to 21 years. Their racial stock was largely Scandinavian. The measurements were made as follows, with all clothing of the subjects removed. Height—subjects back to wall upon which a vertical scale was placed, the readings taken to one-fourth inch; Weight—taken to one-fourth pound, on a standard Fairbanks Scale; Chest-circumference—to one-fourth inch at nipple level during quiet respiration.

Broader unit grouping of measurements than indicated above was used in my calculation, and the group as a whole is not identical with that reported by Jackson, inasmuch as certain records were excluded which did not contain all three pertinent measurements. Furthermore individuals who fell extremely off the trend of the mass of material were omitted from the correlation tables.

Sample V. United States Army Officers' Examination

Reports of the annual physical examination of United States Army Officers made in 1924, substantially the same as those used for a study of blood pressure by G. C. Dunham (10) were utilized for calculation of correlation coefficients. The subjects were over 20 years. In the calculations age was grouped in 5 year periods, height in inches, chest circumference in inches and weight in five pound intervals. Subjects were nude for examination.

Sample VI. Citizens' Army Training Corps Physical Examination

The results of calculations of the means and intercorrelations from the measurements of height, weight, and chest circumference of some 100,000 attendants at the Citizens' Army Training Camp and Reserve Officers' Training Camp, by Col. A. G. Love, U.S.A. were made accessible to me by the author for the purposes of this study.

The subjects were native whites of either native or foreign parentage. Height and chest circumference are recorded in inches, weight in pounds.

RESULTS

The statistics tabulated for each of the groups separately are as follows:

TABLE 6

Sample I. Woodbury's Statures and Weights

AGE	MEAN		σ		r	NUMBER
	Height	Weight	Height	Weight	Height-Weight	
1 mo.....	21.16 ± .04	9.11 ± .05	1.43	1.77	.668 ± .018	595
1–2 mo.....	22.47 ± .02	10.88 ± .03	1.29	1.89	.622 ± .011	1,431
2–3 mo.....	23.58 ± .02	12.61 ± .03	1.25	2.04	.601 ± .009	1,754
3–4 mo.....	24.53 ± .02	14.12 ± .03	1.30	2.19	.617 ± .010	1,826
4–5 mo.....	25.35 ± .02	15.32 ± .03	1.30	2.28	.610 ± .010	1,863
5–6 mo.....	26.08 ± .02	16.58 ± .04	1.45	2.53	.688 ± .008	1,809
6–9 mo.....	27.15 ± .01	18.24 ± .02	1.57	2.68	.691 ± .005	5,509
9–12 mo....	28.46 ± .01	20.08 ± .02	1.51	2.60	.656 ± .005	5,512
1–2 years...	31.35 ± .01	23.67 ± .02	2.03	3.20	.768 ± .002	15,313
2–3 years...	35.06 ± .01	28.54 ± .02	1.95	3.58	.675 ± .003	15,071
3–4 years...	37.96 ± .01	32.55 ± .02	1.98	3.85	.720 ± .003	14,182
4–5 years...	40.35 ± .01	35.93 ± .03	2.07	4.14	.740 ± .003	12,423
5–6 years...	42.61 ± .02	39.59 ± .03	2.13	4.65	.742 ± .002	4,983
Total....	.....	.....	.....	.....	.....	82,271

TABLE 7

Sample II. United States Public Health Service Survey

AGE	MEAN			σ			r			NUMBER
	Height	Weight	Chest Circumference	Height	Weight	Chest Circum.	Height-Weight	Height-Chest Circumference	Weight-Chest Circumference	
6	45.299 ± .061	46.23 ± .17	22.734 ± .042	1.98	5.55	1.37	.808 ± .012	.492 ± .023	.690 ± .016	488
7	47.305 ± .058	50.65 ± .17	23.331 ± .036	2.17	6.22	1.35	.8280 ± .0084	.413 ± .022	.624 ± .016	637
8	49.541 ± .055	56.99 ± .18	23.990 ± .038	2.140	7.03	1.47	.7900 ± .0097	.481 ± .020	.640 ± .015	685
9	51.686 ± .056	62.23 ± .20	24.707 ± .038	2.270	8.23	1.540	.761 ± .010	.454 ± .020	.704 ± .012	746
10	53.431 ± .059	68.08 ± .26	25.330 ± .043	2.361	10.28	1.736	.739 ± .011	.507 ± .019	.720 ± .012	733
11	55.472 ± .052	75.16 ± .26	26.121 ± .040	2.345	11.43	1.774	.746 ± .010	.499 ± .017	.7575 ± .0096	893
12	57.199 ± .055	81.96 ± .30	26.873 ± .032	2.520	13.68	1.45	.725 ± .010	.514 ± .016	.7742 ± .0088	951
13	59.313 ± .065	91.04 ± .34	27.831 ± .045	3.049	16.03	2.114	.7898 ± .0081	.563 ± .015	.8080 ± .0074	995
14	61.475 ± .077	101.43 ± .46	29.040 ± .059	3.237	19.16	2.475	.7711 ± .0096	.587 ± .016	.8372 ± .0071	804
15	62.18 ± .21	104.5 ± 1.1	29.26 ± .13	3.40	17.7	2.15	.781 ± .024	.641 ± .037	.784 ± .024	118
Total.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	7,050

TABLE 8

Sample III. United States Public Health Service Posture Study

AGE	MEAN			σ			r			NUMBER
	Height	Weight	Chest Circumference	Height	Weight	Chest Circum.	Height-Weight	Height-Chest Circumference	Weight-Chest Circumference	
6– 7	45.38 ± .16	44.20 ± .39	57.39 ± .18	2.37	5.80	2.72	.728 ± .031	.725 ± .032	.786 ± .025	101
7– 8	48.75 ± .14	51.03 ± .45	59.89 ± .19	2.26	7.32	3.00	.703 ± .032	.588 ± .041	.688 ± .033	118
8– 9	50.60 ± .15	55.70 ± .57	61.71 ± .20	2.14	8.24	2.95	.699 ± .035	.515 ± .051	.747 ± .031	95
9–10	53.07 ± .13	62.90 ± .56	63.89 ± .22	2.05	9.62	3.53	.656 ± .036	.514 ± .046	.790 ± .023	117
10–11	54.24 ± .13	67.06 ± .60	65.09 ± .21	2.33	10.84	3.84	.719 ± .027	.619 ± .034	.830 ± .017	148
11–12	56.58 ± .15	75.89 ± .73	67.83 ± .27	2.60	12.52	4.54	.723 ± .028	.646 ± .034	.871 ± .014	132
12–13	58.16 ± .19	83.54 ± .96	69.82 ± .33	2.81	14.42	4.95	.602 ± .042	.564 ± .045	.865 ± .017	103
13–14	60.56 ± .22	92.54 ± 1.2	72.01 ± .33	3.33	18.04	5.01	.751 ± .068	.685 ± .035	.852 ± .018	106
14–15	62.67 ± .20	100.17 ± .96	74.62 ± .27	3.14	15.20	4.28	.760 ± .027	.628 ± .038	.862 ± .016	113
15–19	66.80 ± .11	125.33 ± .71	81.48 ± .71	3.01	18.99	5.25	.711 ± .018	.562 ± .026	.846 ± .009	322
20–24	67.96 ± .13	142.03 ± .72	85.11 ± .20	2.73	15.32	4.30	.481 ± .04	.263 ± .044	.786 ± .018	206
25–29	68.17 ± .13	145.81 ± .84	85.84 ± .22	2.55	17.37	4.60	.462 ± .038	.234 ± .046	.780 ± .019	196
30–34	68.05 ± .18	151.7 ± 1.5	87.73 ± .34	2.55	21.70	5.74	.567 ± .047	.349 ± .061	.897 ± .014	94
35–39	67.59 ± .23	155.8 ± 1.8	89.50 ± .53	2.54	20.34	5.84	.191 ± .087	.157 ± .087	.892 ± .019	56
40–49	67.79 ± .30	158.7 ± 2.3	90.64 ± .66	2.88	21.60	6.38	.601 ± .066	.313 ± .090	.856 ± .027	42
50–59	67.11 ± .22	156.1 ± 2.3	91.27 ± .66	2.19	22.50	6.50	.603 ± .081	.458 ± .090	.826 ± .057	44
60+	67.28 ± .32	146.9 ± 3.0	88.60 ± .10	2.36	22.30	7.44	.504 ± .087	.40 ± .11	.885 ± .029	25
Total.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,018

TABLE 9

Sample IV. University of Minnesota Students

AGE	MEAN			σ			r			NUMBER
	Height	Weight	Chest Circumference	Height	Weight	Chest Circum.	Height-Weight	Height-Chest Circumference	Weight-Chest Circumference	
17	68.49 ± .13	138.11 ± .74	35.08 ± .09	2.74	16.11	1.87	.637 ± .027	.382 ± .040	.746 ± .020	216
18	68.98 ± .08	139.63 ± .49	34.75 ± .07	2.33	14.64	1.94	.484 ± .026	.255 ± .031	.726 ± .016	407
19	68.94 ± .10	142.64 ± .69	35.28 ± .08	2.57	16.49	2.09	.580 ± .026	.271 ± .037	.768 ± .016	292
20	68.86 ± .11	142.39 ± .77	35.13 ± .10	2.37	16.54	2.11	.544 ± .032	.305 ± .041	.751 ± .020	220
21	69.06 ± .13	143.59 ± .82	35.11 ± .11	2.23	13.80	1.79	.521 ± .044	.144 ± .058	.659 ± .034	128
Total..	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,263

TABLE 10

Sample V. United States Army Officer's Examination

AGE	MEAN			σ			r			NUMBER
	Height	Weight	Chest Circumference	Height	Weight	Chest Circum.	Height-Weight	Height-Chest Circumference	Weight-Chest Circumference	
20–24	69.043 ± .080	148.20 ± .39	34.880 ± .065	2.59	16.04	1.87	.520 ± .022	.243 ± .080	.681 ± .017	483
25–29	69.228 ± .034	151.85 ± .28	35.350 ± .033	2.31	19.45	2.22	.508 ± .011	.288 ± .013	.7858 ± .0056	2,148
30–34	69.090 ± .026	154.19 ± .23	35.723 ± .021	2.29	20.20	2.34	.483 ± .0088	.363 ± .010	.7988 ± .0042	3,432
35–39	68.959 ± .036	157.14 ± .32	36.762 ± .039	2.37	21.41	2.55	.451 ± .012	.248 ± .014	.8136 ± .0052	1,946
40–49	68.927 ± .029	161.50 ± .28	36.852 ± .034	2.27	22.44	2.68	.439 ± .010	.238 ± .012	.8330 ± .0039	2,850
50–59	68.831 ± .051	163.46 ± .50	37.169 ± .062	2.18	21.55	2.67	.337 ± .021	.160 ± .062	.8103 ± .0079	845
60 +	69.04 ± .17	170.4 ± 1.1	37.68 ± .27	2.05	13.04	3.19	.596 ± .054	.392 ± .071	.861 ± .002	65
Total.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	11,769

TABLE 11

Sample VI. Citizens Military Training Camp

AGE	MEAN			r			NUMBER
	Height	Weight	Chest Circumference	Height-Weight	Height Chest Circumference	Weight-Chest Circumference	
16	66.92 ± .029	128.09 ± .19	30.93 ± .02	.5712 ± .0072	.3355 ± .0095	.7189 ± .0072	3,983
17	67.40 ± .010	130.79 ± .068	31.31 ± .0080	.5244 ± .0029	.2954 ± .0036	.7112 ± .0029	28,727
18	67.79 ± .0096	134.39 ± .065	31.79 ± .0076	.4934 ± .0029	.2538 ± .0035	.7007 ± .0029	31,709
19	68.07 ± .013	137.71 ± .085	32.20 ± .010	.4751 ± .0038	.2385 ± .0046	.6828 ± .0038	19,197
20	68.10 ± .017	139.80 ± .11	32.45 ± .013	.4766 ± .0051	.2370 ± .0062	.6704 ± .0051	10,591
21	68.16 ± .023	140.87 ± .15	32.63 ± .018	.4673 ± .0068	.2295 ± .0083	.6592 ± .0068	5,941
Total.....	.....	.....	.....	.....	.....	.....	100,148

ANALYSIS

I may now take up the task of synthesizing the results into a picture that presents the influence of changing age upon the correlations considered.

For the purpose we will wish to know the correlations at successive age points. Since it is to be presumed that each of the variables independently changes with age, it is necessary that the grouping of age be not so broad that the statistics of the variables included within its limits are affected by their trend on age during this interval. In what follows, I take as the most pertinent consideration in hand the direction and amount of change in the coefficient from age to age, rather than its absolute value at any point. With this in mind, it is to be noted that the age groupings used were fine enough to insure the conclusion that the trends obtained were the same in their essential characters as would be gotten with greater refinement of grouping.*

1. *Correlation between Height and Weight*

Birth through 6 Years.—In this age range, I have been able to secure only one series of data from which reliable correlation coefficients could be calculated, that of Woodbury. These data, however, contain exceedingly large numbers,—over 80,000 in total—and the extreme smoothness of the trend of the mean characters with age, indicates that it is, for such a statistical study as I am making, homogeneous.

The values found are shown graphically in the section 0–6 years of Figure 1 with a smooth curve, representing the trend, drawn through them.

The notable features of the curve as drawn are three in number—(1) the rise from birth to about 1½ years, (2) the fall from the 1½ years through about age 3, and (3) the rise from age 3 to somewhat beyond age 6.

The rise from birth to nearly age two is, in my opinion, sufficiently well established by the trend of the observed points, and stands on that basis.

The dip between 1½ and 6 years, however, representing first a fall and then a rise in the trend line, is on the grounds of the position of the observed points themselves, established with less certainty.

* The method for estimating the effect of grouping is given in the Appendix.

There is, however, some evidence extraneous to the positions of the observed correlations themselves which adds to their weight, and which constituted the supporting reasons for inserting the character in question into the trend line. The evidence referred to is the following:

As has been observed before and explained in the Appendix, the correlation coefficients in the series comprising Sample I were calculated from the regression coefficients obtained from fitted lines, and the standard deviations of the variables concerned. Each of these

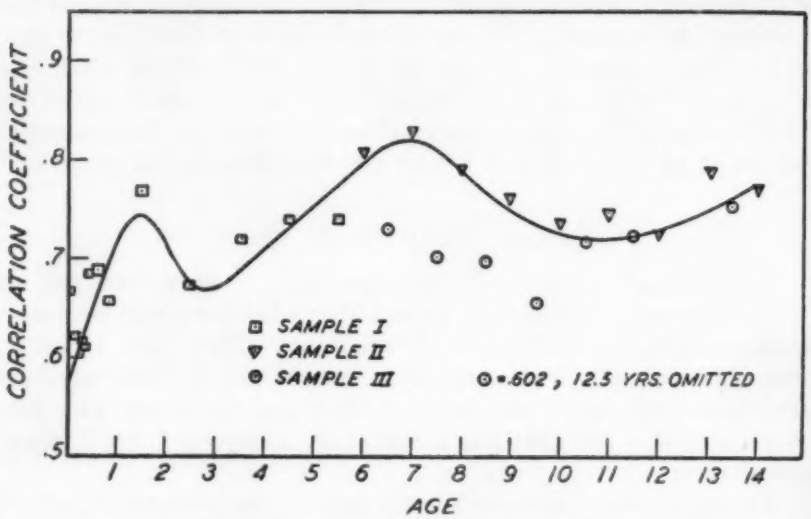

FIG. 1. HEIGHT-WEIGHT CORRELATION AGAINST AGE—BIRTH THROUGH 14 YEARS

functions, regression coefficient, standard deviation of height, and standard deviation of weight, separately shows a smooth regular trend with age, with no questionable change of direction in the period between 1½ and 6 years, equivalent to the dip of the correlation trend. If now, from the smoothed values of the functions, correlations are calculated at each age separately, the same dip in the trend of correlation coefficients on age is apparent as was obtained when observed values of the functions were used. Therefore, such doubts of the curvature changes in the trend of the correlation as arise from the seemingly abrupt changes in direction disappear, and on these grounds I have retained the curvature characters shown, as probably representative of the true trend.

Age 6 through 14 Years.—For this period are available from my own calculations, correlations derived from Sample II and Sample III. The results for these are shown graphically in the 6–14 year section of Fig. 1, together with a smooth curve taken as the trend in this period.

This line is almost entirely established by the points from Sample II, which contains large numbers and is therefore taken as the determinative one of the series. So fixed, the line is directly continuous with that established for the 0–6 year period. Regarding the points of Sample III, that at age 12.5 years is so discordant with the total series as to warrant discarding; those at 10.5, 11.5 and 13.5 years agree well with the trend drawn. The four remaining points of this series at the consecutive ages 6.5, 7.5, 8.5 and 9.5 years all fall below this line, but their trend, taken together agrees fairly well with that established by the other points.

The essential features of the trend in this period are the fall from six years to about eleven years and the rise from this age. As regards these features, the points distributed about the line as in Figure 1, or those of Sample II and Sample III taken independently are in good agreement.

Coming now to the bearing of previous investigations on our present findings, we have three series which have correlations falling in the period under consideration, that of Boas and Wissler, that of Baldwin, and that of Mumford and Young. The absolute values of these do not agree with each other or with my results. Further, while the coefficients are "significant," they fluctuate too much within each series to establish a trend, taken by themselves, with definiteness. If the findings are to be regarded as pertinent at all, it can, therefore, be only in respect to their broad agreement or disagreement with my results. With the consideration in mind that it is the curvature character of the trend line rather than its absolute level that is our interest here, I have, therefore, inquired in relation to these investigations, "Do the results agree with the theory that between the ages six and fourteen years broadly, there is first a fall, then a rise, in correlation?" I have sought to obtain an answer to that question by a graphical analysis, which lack of space does not permit me to present here, but which can be easily reproduced from the figures in Tables 1, 3, and 4. For each series consulted a trend line was drawn through the correlations, having the postulated characters. For each of the three series taken seperately, and excepting two points in the series of Boas and Wissler, the correlations deviated from the line in no instance by more than 2 × P.E. and

in most cases 1 × P.E. Remembering that 3 × P.E. is generally considered a minimum limit of significant difference, it may therefore be said that these correlations might, with reasonable probability, have been observed as random samples from a trend of correlations having the characters in question. Boas and Wissler's series shows from 6 years through 9 years the decline of the coefficient indicated in my results. At ages 13 and 14 years the correlations are relatively high, indicating a rise from the low level previously reached, which is again in agreement with my findings. However, at 10 years and 11 years the coefficients stand at the high levels of .83 and .88. These two determinations disturb abruptly what would otherwise be a smooth trend agreeing with my findings. To that extent this series disagrees with my conclusions.

Ages 14 *Years Forward.*—In this period are available correlations from Sample II, Sample III, Sample IV, Sample V and Sample VI. The results are shown graphically in Figure 2. The absolute values

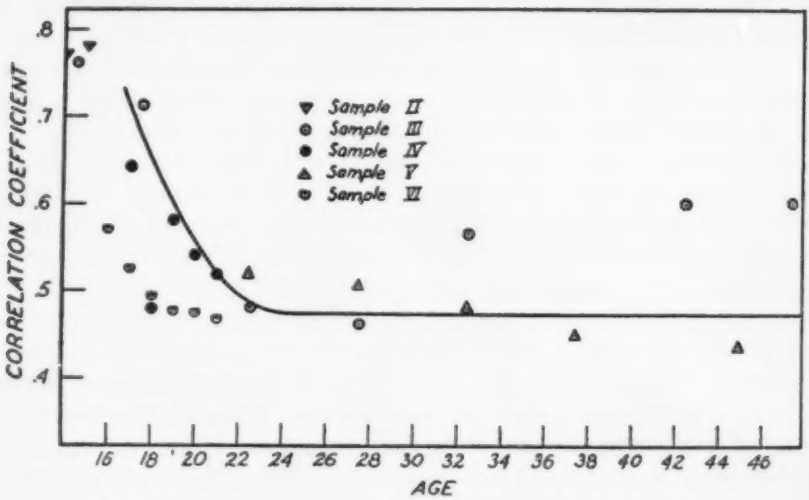

FIG. 2. HEIGHT-WEIGHT CORRELATION AGAINST AGE—14 YEARS FORWARD

of the coefficients are not in agreement, a fact that I attribute to differences in selection of the populations concerned. Sample III is probably most representative of the general population in this age range; moreover, it is continuous with the antecedent portion of the general trend, and is taken as the basis for placement of the absolute level of the trend in this period. Two features dominate this terminal

portion of the trend, (1) the rapid decrease of the coefficient till about the twenty-second year, and (2) subsequent leveling off to a comparatively constant value.

Between 14 and 21 years, the three series containing relevant points agree in the character of a rapid decrease. Following this, III and V disagree, III showing literally a slow rise and V a similar decline. The populations concerned, however, are only questionably representative and the evidence from both is taken only to point to a comparative constancy of the coefficient after twenty-two years.

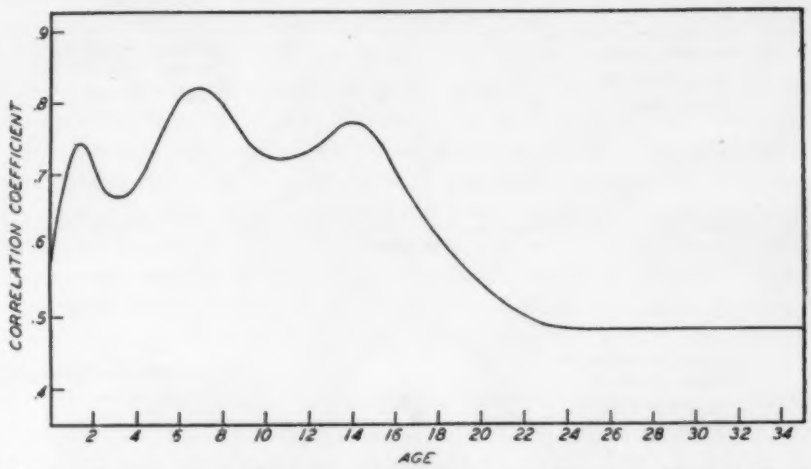

FIG. 3. HEIGHT-WEIGHT CORRELATION TREND ON AGE—SMOOTHED VALUES, BIRTH FORWARD

The series of Baldwin as well as that of Mumford and Young, insofar as they contain points in the period 14 to 21 years, show an unequivocal decline, in agreement with my results.

The series of Schuster stands by itself in that the determinations contained therein show a clear and well defined trend that is directly opposed to all the other findings. What is the explanation of the contradiction, I am unable to say. But it is to be noted that the trend with age of Schuster's series of height and weight measurements is to be suspected on the grounds that in respect to either height or weight, the means show a decrease in going from a lower to a higher age at ages 19, 20, and 22 years.

Combining the determinations for each period described, now, we obtain the curve shown in Figure 3 as representative of the

changes of the height-weight correlation with age over the entire life range.

Relations of the Height-Weight Correlation Trend to Other Features of the Growth of Height and Weight.—The trend, then, is seen to consist of a series of wave-like changes, alternating maximum and minimum values of the coefficient. It is to be presumed that these changes are reflective of alterations in the underlying physiologic complex that

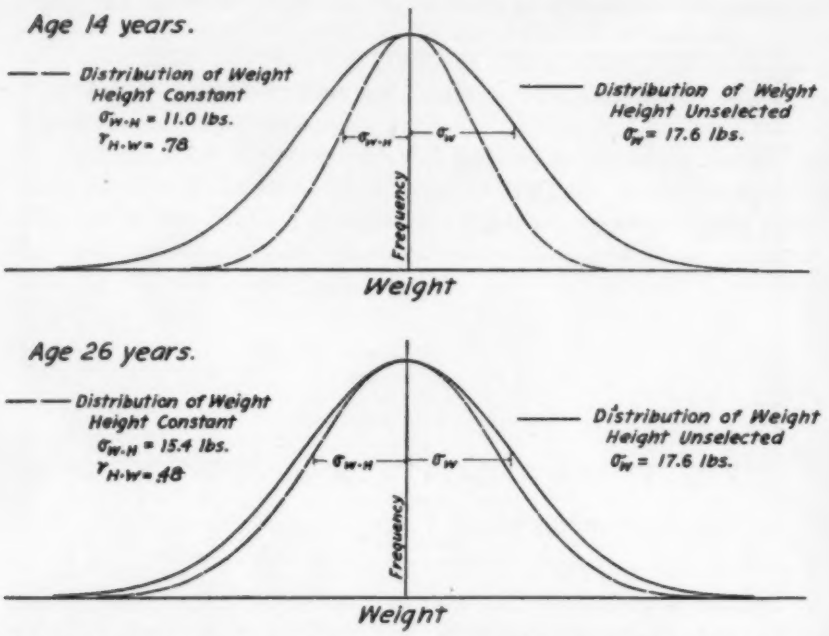

FIG. 4. ILLUSTRATIVE REDUCTION OF VARIABILITY RESULTING FROM CORRELATION

affects height and weight. To be explicit we may take the values of the height-weight correlation for two ages found to be different and inquire into the meaning of their inequality. Using smoothed values we find r_{hw} at age 14 years is .78; at 26 years, it is .48 It will be enlightening to interpret the decrease of the coefficient observed to occur between these two ages by the change it implies for the variability of weight. I have pictured this graphically in Figure 4. At age 14 years, as also at 26 years, the variability of weight, for a population of mixed height, is measured by σ_w = 17.6 pounds. If now, at age 14

years individuals of some particular height are chosen,* the weight variability of the resulting group will be found by the same measure to be only 11.0 pounds. Something in the fixation of height also fixes to a degree, weight, thus diminishing its variability. The same procedure, followed with individuals of 26 years also reduces the variability of weight, but not to an equal extent, i.e., from 17.6 pounds only to 15.4 pounds. We see, then, that at age 26 years fixation of height does not fix weight as rigidly as it does at 14 years. This is another way of presenting the fact that the correlation between height and weight is greater at 14 years that at 26 years. We may offer an explanation, in general terms as follows.

At age 14 years a certain number of factors, a, b, c, d—, A, B, C, D—etc., determine weight, of which a part, A, B, C, D, let us say, are also influential in the determination of height. When the latter are held comparatively fixed by maintaining height constant, weight is permitted to vary only by the changeability of the remaining factors a, b, c, d—etc., and the greater the relative importance of the common factors A, B, C, D, etc., the more will the fixation of height reduce the variability of weight. In these terms, we may say that at age 26 years the factors A, B, C, D—etc., which are influential in the joint determination of height and weight, are, as a group, less effective than at 14 years.

Now, while this sort of knowledge does not, alone, give immediate insight into what the factors are or how they operate, the tracing of the variation to which the correlation is subject, as the life of the individual progresses, may be expected to reveal the points at which they undergo especial change, and so allocate crucial ages in the physiology of growth.

We have found some evidence for the existence of such crucial ages in the fluctuations of the height-weight correlation trend. Are there indications of similar fluctuations in other features of the growth of height and weight?

We have, now, to compare these with the correlation trend, and for that purpose may conveniently review the pertinent definitive characters of the latter as follows:†

(1) A maximum point at about 1.5 years, produced by a rise from birth to that age, and a subsequent decline

* Theoretically it does not matter which particular height is chosen; practically it makes only an insignificant difference in σ_w.

† Vide Fig. 3.

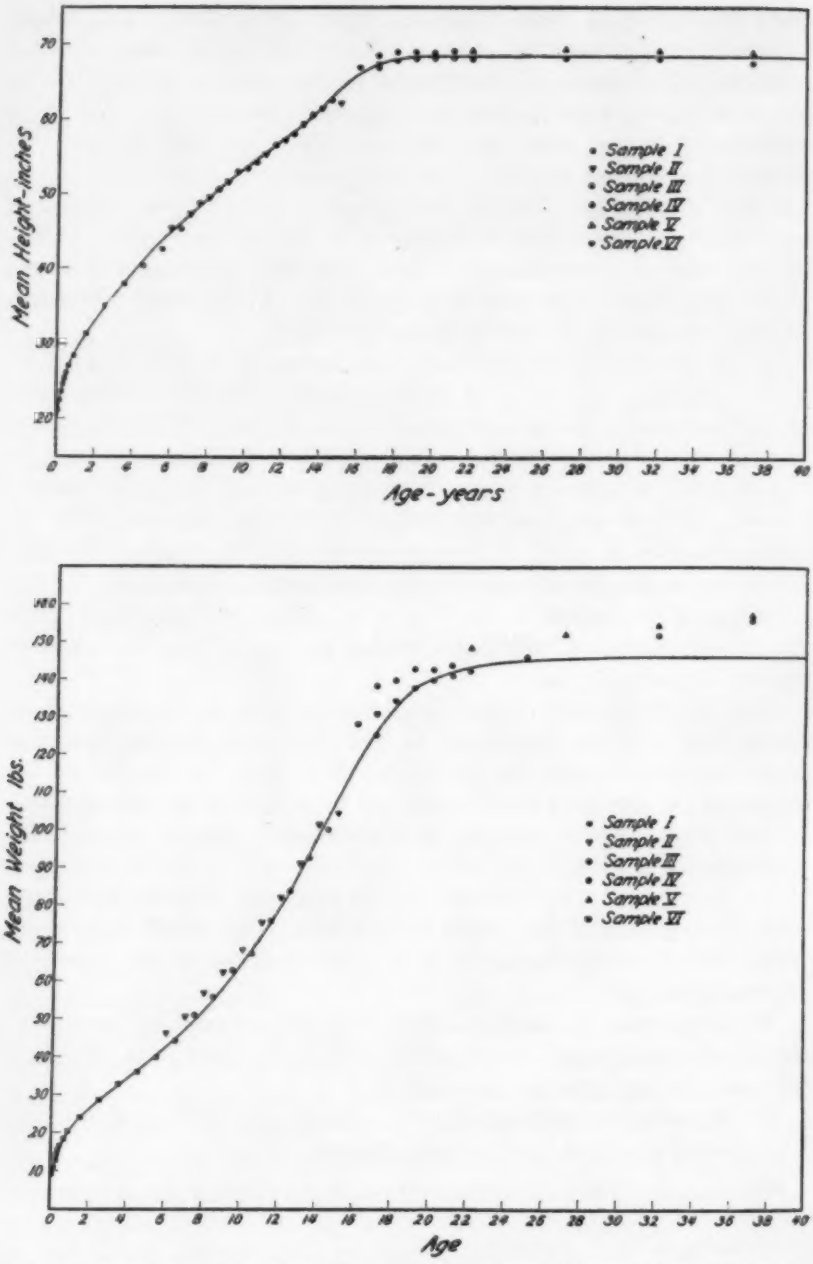

FIG. 5. MEANS AGAINST AGE; UPPER FIGURE HEIGHT, LOWER FIGURE WEIGHT

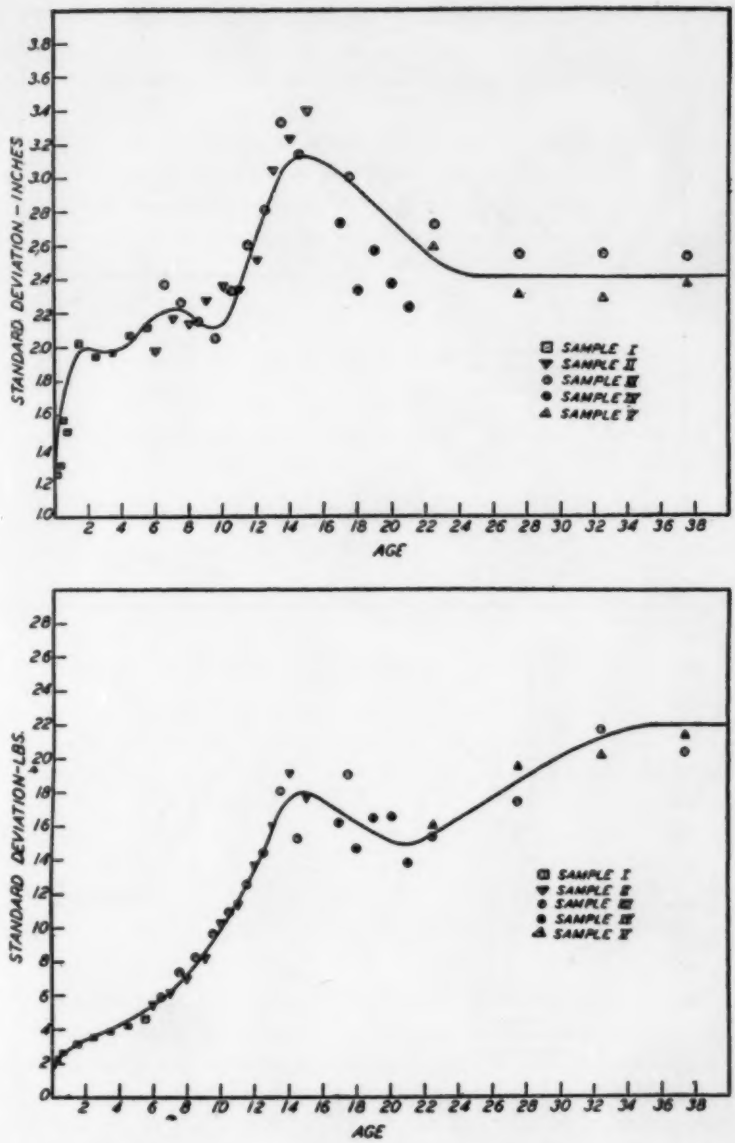

FIG. 6. STANDARD DEVIATION AGAINST AGE; UPPER FIGURE HEIGHT, LOWER FIGURE WEIGHT

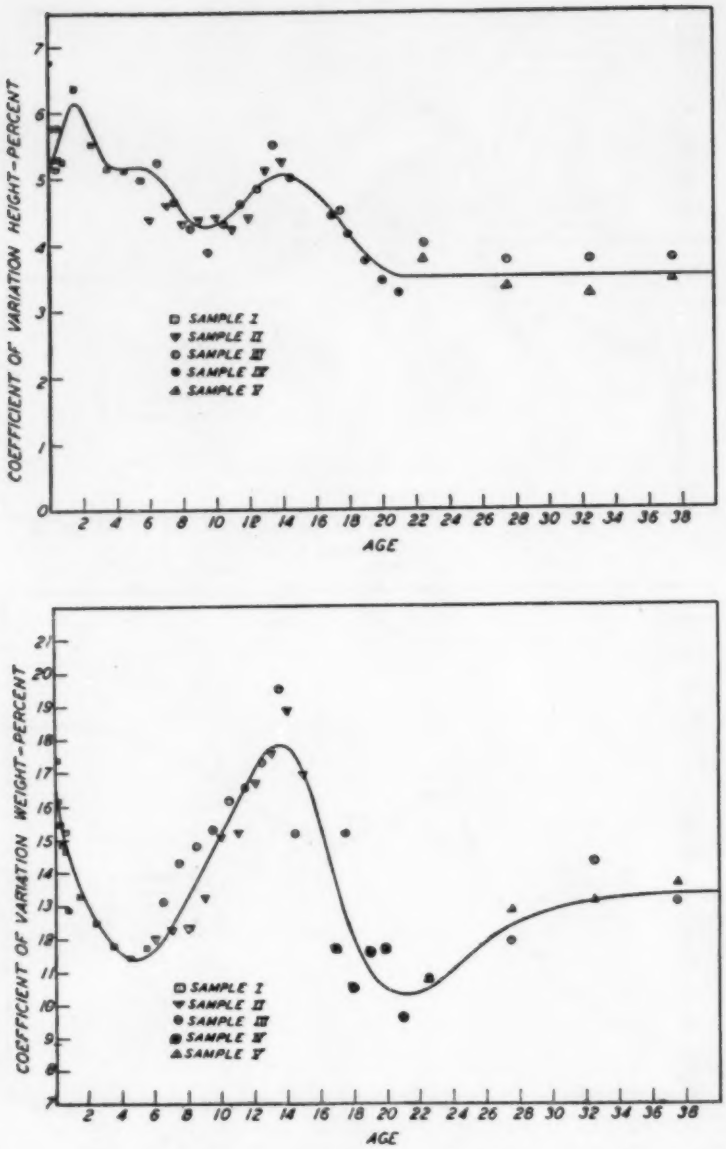

FIG. 7. COEFFICIENT OF VARIATION AGAINST AGE; UPPER FIGURE HEIGHT, LOWER FIGURE WEIGHT

(2) from 1.5 years to a minimum at about 3 years, from which the trend rises to

(3) a maximum $r = .83$ at about 6.5 years, the highest point in the series,

(4) a fall to a minimum at about 11 years, following which there is

(5) a rise to a maximum at about 14 years, followed by

(6) a final fall to a constant level at about 21 years.

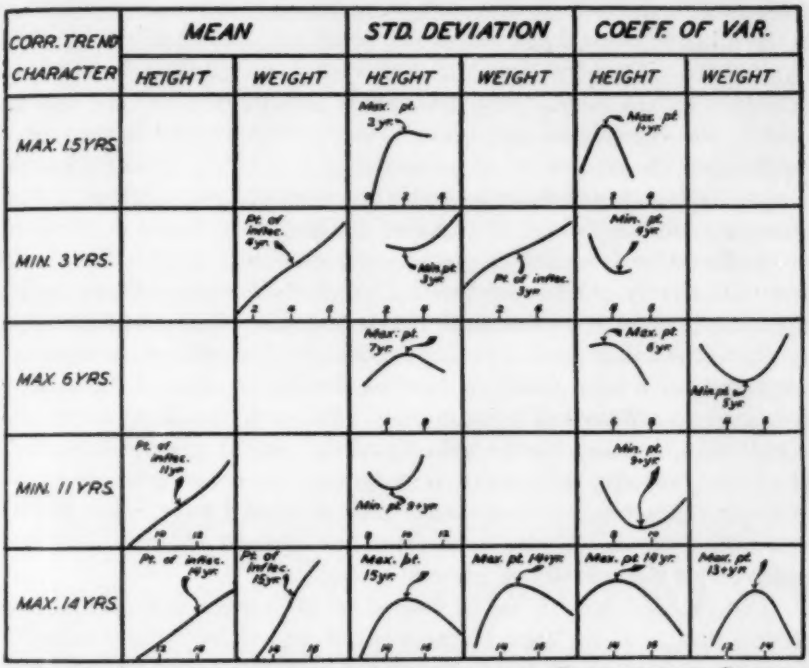

FIG. 8. GRAPHICAL COMPARISON, CRUCIAL AGES OF HEIGHT-WEIGHT CORRELATION TREND AND TRENDS OF MEANS, STANDARD DEVIATIONS, AND COEFFICIENTS OF VARIATION

Let us consider, first, the age changes of the more ordinary statistical functions, means, standard deviations, and coefficients of variation. The trends for these appear graphically in Figures 5, 6, and 7. No effort has been made to achieve a finished critical smoothing of the material except in particular parts, where the procedure was germane to the matter in hand, i.e., the fixing of the critical points in the changes of function.

One point of similarity between all the curves shown stands out, and may be considered unequivocally characteristic, the turning point

following soon after age fourteen years. The trend with age of all the statistical measures considered shows a marked decline soon after the age of adolescence, and I think it is fair to consider that the phenomenon is connected with the changes that are characteristic of the period after puberty. I therefore refer to the decrease of the correlation at that time as the "post pubescent decline."

Except for the phase of post pubescence just described, such analogy with the critical ages of the correlation trend as are discernible in the other functional age trends are, in my opinion, of only suggestive significance. Figure 8 gives in tabular form, the similarities that are indicated by the data. The descriptive parallel between the critical ages in the correlation trend and that of the standard deviation of height and the coefficient of variation of height* lends considerable support to the theory that these ages are physiologically critical. The observations from which the analogies are drawn, however, show so much deviation from their central positions, that I suggest them only very tentatively. What are needed to clarify these points, are large, statistically homogeneous samples in the regions of the ages in question.

Correlation Changes and the Rate of Growth:—Several of the observations that have been made relevant to the age changes of the means, are suggestive of further investigation. Where a "point of inflection" is indicated, a change in the velocity of the rate of growth is implied. Moreover, velocity of growth is suggested on other grounds to be cyclic in character, and hence analogous to what I have found for the correlation trend. These considerations prompt a more detailed inquiry into the velocity of growth as such.

The rate of growth is, of course, a derivative function of the growth itself. If we know the amount of growth up to each point in time, the rate at which it has proceeded from one point to another is implicit and calculable. Measurement of the rate, therefore, refers back to the determination of the time trend. Attempts to accomplish such determinations in respect to height and weight of man are scattered in the literature. For the most part fragmentary, they are inconclusive in regard to the ages most pertinent to the investigation in hand. Where the conclusions are more general and applicable, as for instance in the studies of S. Brody (8), I am unfortunately unable to agree with their soundness.

My own approach to the problem of determining the changing velocity of growth at different ages is designedly of a preliminary and

*The latter of course, being a derivative of the former, reflects its fluctuation.

empirical character. The subject is at present confused by attempts to achieve general laws of growth that will apply over the entire age range, and for different biological variables, when, in fact, the nature of the curvature changes in the constituent periods have not been adequately elucidated or even systematically attempted. Any comprehensive analysis of the question must involve, I think, at least the following procedures:

1. The determination of the number and position of the inflection points of the time trend.
2. The analysis of the differential character of the constituent parts.
3. The synthesis in the simplest possible equational form of (1) and (2) for the entire life range.

My efforts have been confined solely to (1) and (2) of that outline, and within the scope of these, I have proceeded only so far as will bring the analysis of the rate of growth parallel to that of the correlation trend. The method followed for determining the rates was basically graphical. The slopes at successive ages were estimated from the smoothed graph of the time trend of height and weight respectively and the rates so obtained smoothed in their trend on time. For percentage rates, the first order rates were divided by the value of the height or weight at the age in question. The results are shown as curves in Figure 9. The notable characters are seen to be the following:

Height

1. A rapid decline of the rate from birth to about 1 year (17 inches per year to 5 inches per year).
2. A more gradual decline to about 11 years (5 inches per year to 2 inches per year).
3. A short rise to about 14 years (2 inches per year to 2.5 inches per year) following which there is
4. A gradual fall of the rate, reaching zero at about 21 years.

Weight

1. An extremely rapid fall of the rate from birth to about 1 year (30 pounds per year to 6.5 pounds per year).
2. A slower decrease of the rate from 1 year to 4 years (6.5 pounds per year to 4 pounds per year).
3. A gradual increase of the rate to about age 14 years (4 pounds per year to 10 pounds per year) following which there is
4. A decline of the rate to almost the zero level at about 22 years, at which level it remains until about age 40.

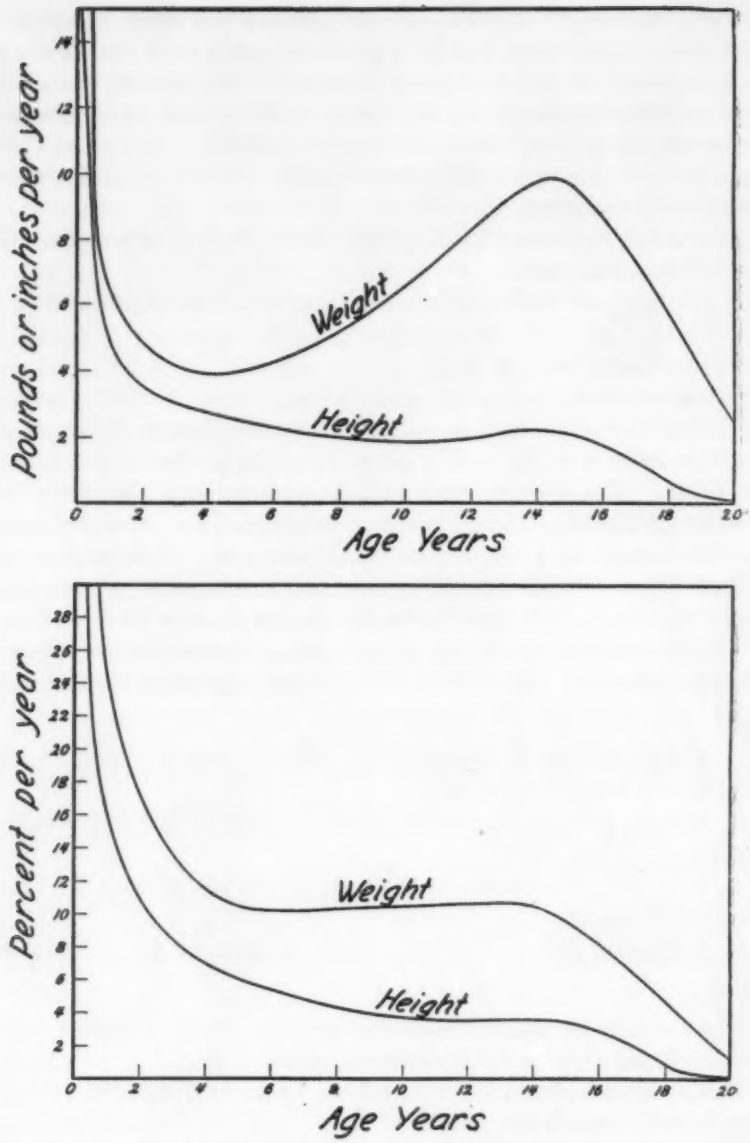

FIG. 9. TREND OF GROWTH RATES ON AGE, HEIGHT AND WEIGHT

The rates of growth expressed as percentages show broadly the same definitive changes in their regression on age as do the first order rates.

A comparison between the critical points of the rate curves and that of the correlation trend is presented in tabular outline in Figure 10. As was the case with the similar tabulation of other comparative characteristics of the height and weight functions, no clear-cut point to point analogy is established. Yet there are suggestive similarities in the critical ages of the several curves. Ages 1, 5, 3, 11 and 14 years have in their neighborhoods some exceptional characteristic in either

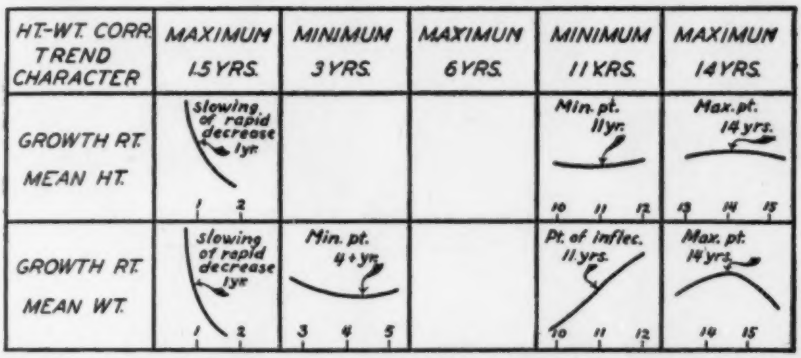

FIG. 10. GRAPHICAL COMPARISON, CRUCIAL AGES IN HEIGHT-WEIGHT CORRELATION TREND AND TREND OF GROWTH RATES OF HEIGHT AND WEIGHT

the height or weight rate curve. Whether or not these are functionally related, is a question of interest, the answer to which requires more extended study than is possible in this investigation.

2. *Correlation between Weight and Chest Circumference*

Birth to 6 *Years.*—No data were available which would constitute a sample sufficiently large to determine the coefficients with reliability and I therefore, did not attempt to establish the trend in this period.

6 *Years to* 14 *Years.*—Here are available, from my calculations the correlations from Sample II and Sample III. The results are shown graphically in Figure 11 with a line drawn through the points along their general trend. It is seen that the two series agree in showing an upward movement of the correlation during this period. However, the absolute values of the coefficients from Sample III are consistently higher than those of Sample II. I take this as *prima facie* evidence

that either the selection of the individuals, or the methods of measuring the variables were different in the two groups. The mean weights of Sample II are higher than those for similar ages in Sample III, a fact probably due to the circumstance that the individuals in the latter group were measured without, and those in the former group with some clothing and the individuals selected on a somewhat different basis in the two samples. We may hypothetically attribute the difference in correlation between height and weight to the same

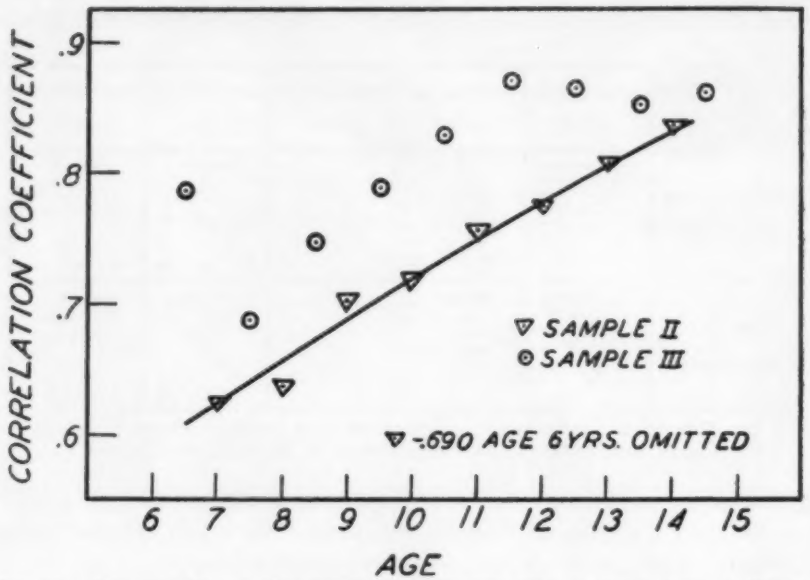

FIG. 11. WEIGHT—CHEST CIRCUMFERENCE CORRELATION AGAINST AGE—6 YEARS THROUGH 14 YEARS

circumstance. So far as this investigation is concerned, the differences are of little significance, since they apparently do not affect the general trend, in regard to which both groups are in essential agreement.

I have taken with some arbitrariness, the points of Sample II as the basis for fixing the position of the trend line, because the correlations of this group are established by the largest numbers of individuals, and because it is probably more representative of the general native population.

Age 14 *to* 21 *Years.*—In this period are available from my series the calculations from Sample II, Sample III, Sample IV and Sample VI.

The results are shown graphically in Figure 12. Again we find an agreement as regards general trend, a decline of the correlation, but a disagreement as to level. I have fixed the absolute position of the curve so that it will have the general trend of the points and be reasonably continuous with the antecedent portion.

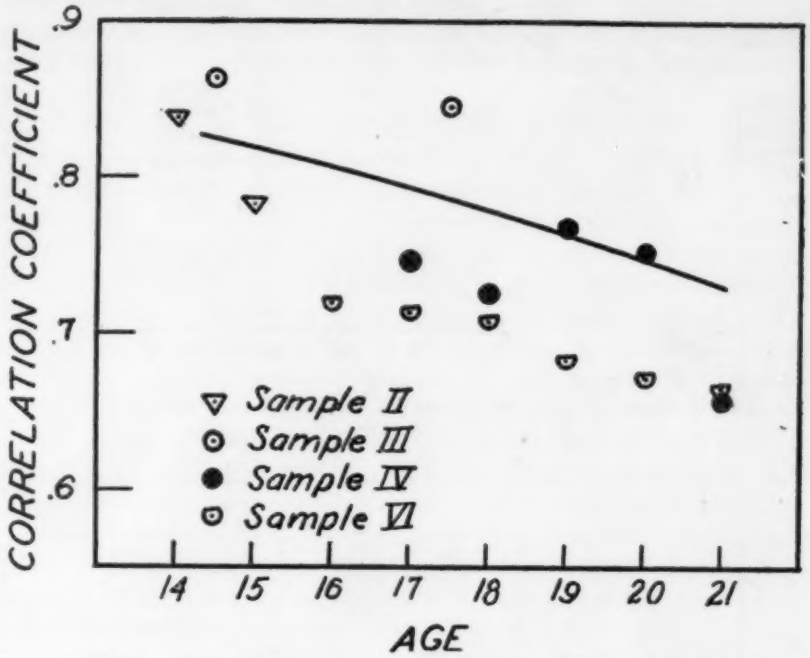

FIG. 12. WEIGHT—CHEST CIRCUMFERENCE CORRELATION AGAINST AGE—14 YEARS TO 21 YEARS

Ages 21 Years Forward.—In this period are available determinations from Samples III, V, and VI. The results for these groups are shown graphically in Figure 13.

They are in agreement in showing after about age 30 years a comparative constancy of the correlation coefficient at a level higher than previously established for the region about the age 21 years, indicating a rise of the correlation with the advance of life from that age.

Combining the results, now, for the entire life range, the trend of the correlation between weight and chest circumference with age is shown in Figure 14.

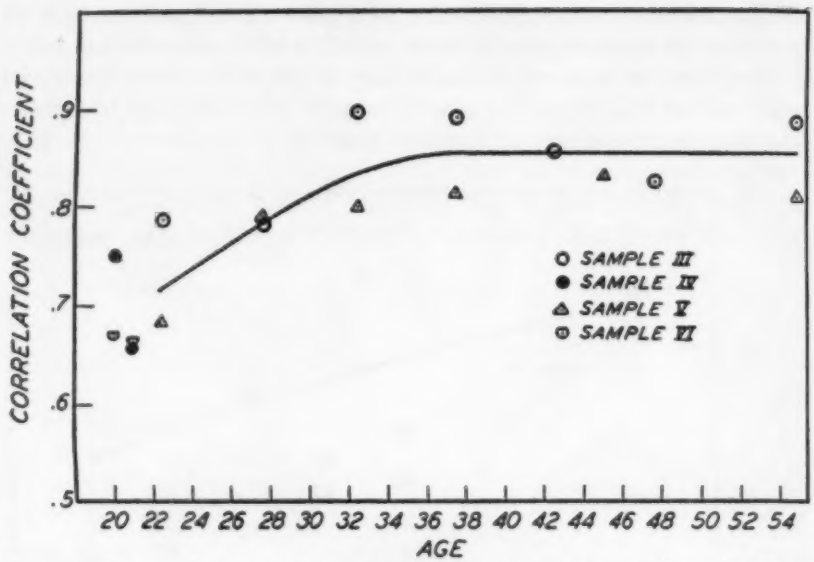

FIG. 13. WEIGHT-CHEST CIRCUMFERENCE CORRELATION AGAINST AGE—21 YEARS FORWARD

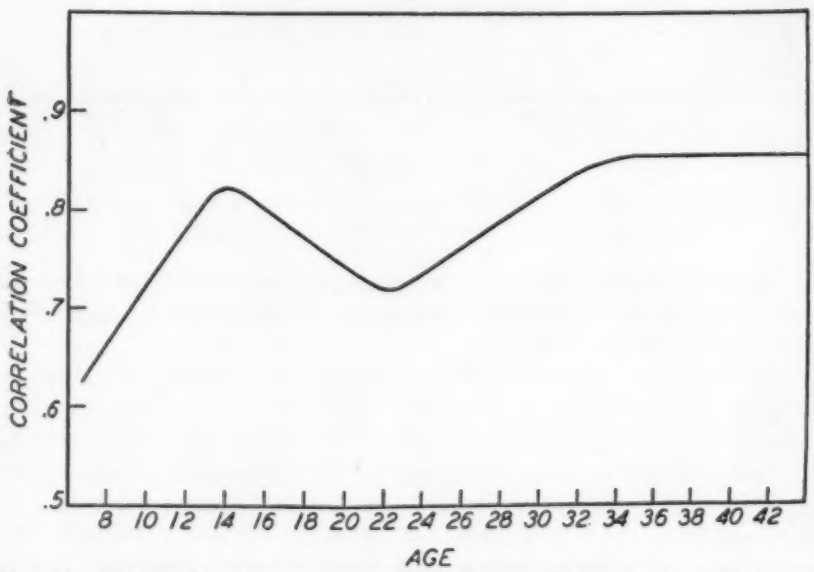

FIG. 14. WEIGHT-CHEST CIRCUMFERENCE CORRELATION TREND ON AGE—SMOOTHED VALUES, 6 YEARS FORWARD

The essential characteristics are seen to be

(1) A rise from 6 years to 14 years.

(2) A decline from 14 years to about 21 years.

(3) A rise from the 21st year with advance of age.

From other investigations there are available for comparison with these results, for the period 6 to 21 years, the findings of Baldwin and those of Mumford and Young. In setting their findings against mine, I take the view expressed in the discussion of the height-weight correlations, of seeking to discover the broad agreement or disagreement of the trend of these with my results. Following the procedure used in making a similar comparison for the height-weight correlations, the weight-chest circumference correlations in question were studied graphically. A trend line was drawn separately through each series used in the comparison which showed the essential feature of the curve obtained from my own results, i.e. a rise from about the 6th to the 14th year, followed by a fall to about 21 years. With such a trend the observations are in good agreement. Almost all the points fall within 1 × P.E. of the trends drawn, and in only one instance does an observation fall outside a 3 × P.E. limit.

Relation of Weight-Chest Circumference Correlation Trend to Other Growth Functions of Weight or Chest Circumference.—What I have called the "post pubescent decline" is evident in the chest circumference measurements, as a decrease in the rate of growth of the mean values of about 14 years and in the weight-chest circumference correlation as a distinct decline in the value of the coefficient. The values of the standard deviation and coefficient of variation of the chest circumference have so great a scatter about their central values, that any attempt to determine decisively their detailed growth characters, seem unwarranted by the data. As regards the standard deviations, however, the data indicate that following the characteristic post-pubescent fall, there is a rise of the variability as measured by that constant.

3. *Correlation between Height and Chest-Circumference*

Birth to 6 Years.—As was the case for the weight-chest circumference correlation, no data were obtainable for a study of the correlation in this period.

6 *Years to* 14 *Years.*—From my calculations are available in this period the correlations derived from Sample II and Sample III.

They are shown graphically in Figure 15 with a trend line drawn through the points. The data here reveal a situation analogous to that presented in the consideration of the weight-chest circumference correlation trend. Both samples concerned agree in indicating a rise of the correlation in this period, but disagree in the absolute values of the coefficients, those from Sample III standing consistently above Sample II. The general explanation ventured in respect to the similar relationship in the weight-chest circumference correlation may

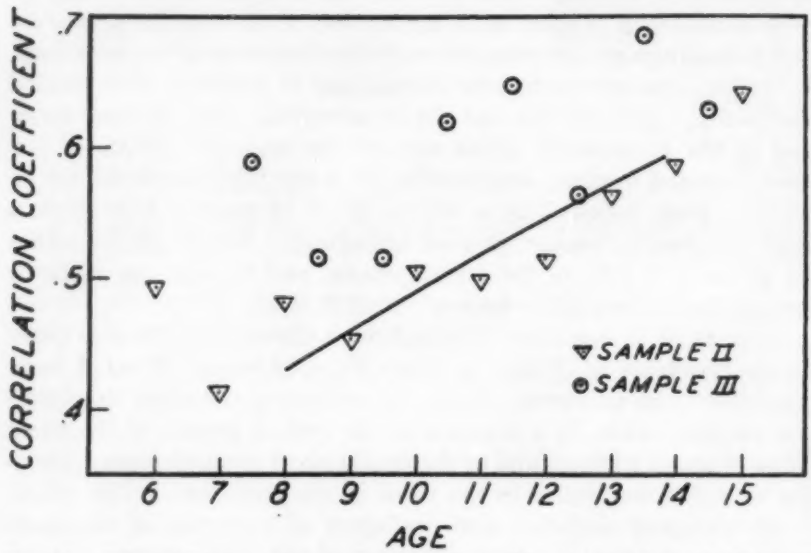

FIG. 15. HEIGHT-CHEST CIRCUMFERENCE CORRELATION AGAINST AGE—6 YEARS TO 14 YEARS

be repeated here. Something in the character of the sample, or method of measurement of one or both of the physical traits involved is consistently different in one group from the other. The chest-circumference measurement shows a larger standard deviation at equivalent age points in Sample II than in Sample III, corroborating this inference, and that is precisely the kind of difference which might affect the correlations in the way indicated by my results. Here again, comparative trend is the feature of the coefficient relevant to my study, and in regard to this, the two series are in substantial agreement. As before, I shall take the points of Sample II as the basis of the absolute level of the trend line, for the reasons previously given.

Age 14 Years Forward.—Here are available from my studies, correlations from Sample II, Sample III, Sample IV, Sample V and Sample VI. The results appear graphically in Figure 16. They all agree in showing a rapid decline of the correlation from 14 years to about 21 years. The points from Sample III are used as the basis for the level of the trend line in this period. From age 21 years forward the points show extreme variation about any central positions, but establish with reasonable definiteness that the correlation is comparatively constant after 21 years at the low level reached by that age.

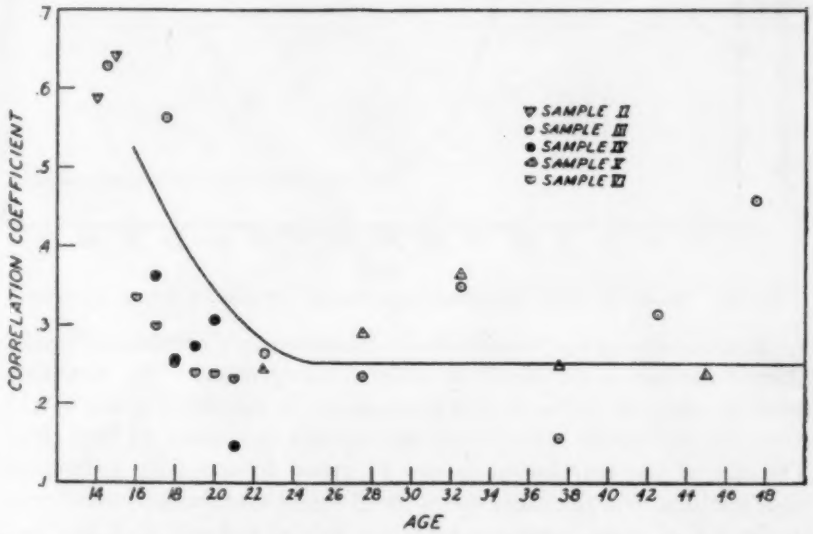

FIG. 16. HEIGHT-CHEST CIRCUMFERENCE CORRELATION AGAINST AGE, 14 YEARS FORWARD

Combining now the results established for the constituent periods studied, we have, as representative of the correlation between height and chest circumference from age 6 years forward, that shown in Figure 17. The definitive features are seen to be

(1) A rise from 6 years to about 14 years.

(2) A very rapid decline to about 21 years.

(3) A comparative constancy of the correlation after the 21st year.

To set against my results we have from other sources, the series of Baldwin and that of Mumford and Young. Careful consideration was given to these after the method used previously for such compari-

son. The conclusion reached is that judged in the light of the probable errors of the points involved, the correlations may well be considered random samples from a trend of correlations which agrees with that derived from my calculations.

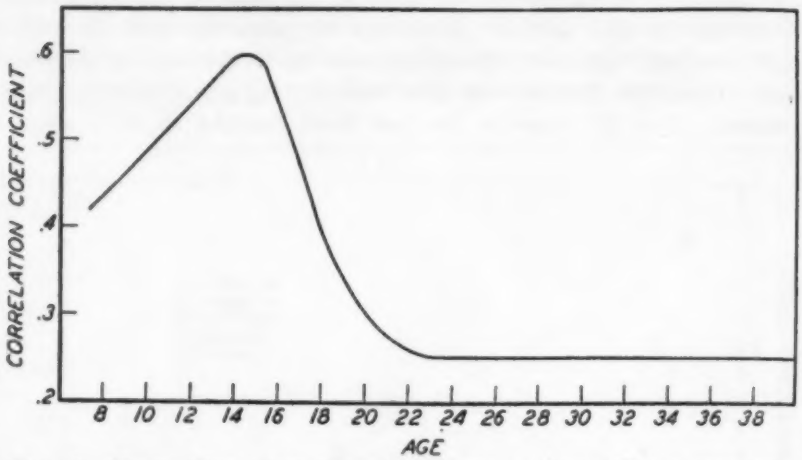

FIG. 17. HEIGHT-CHEST CIRCUMFERENCE TREND ON AGE, 6 YEARS FORWARD

Relationship of the Height-Chest Circumference Correlation Trend to Other Functions of the Height or Chest-Circumference.—The comments made in reference to the similar relations of the age trend of the weight-chest circumference correlations are equally pertinent at this point. The rise of the correlation to age 14 years, followed by a decrease, finds analogy with the other statistics of height and chest circumference in the fall of these functions after the age of puberty that has been previously discussed.

Comparison of the Several Correlations over the Entire Life Range

While my analysis has emphasized throughout this study, questions of trend rather than absolute value of the correlation, and while the sampled populations showed at various points, considerable differences as regards the latter, I believe that my results give an estimate of the absolute values fairly reliable for comparative purposes.

In Figure 18 is presented graphically such a comparison. The definitive characters may be summarized as follows:

(1) Beyond age 10 years the values of the coefficients range highest for weight-chest circumference, next for height-weight and lowest

for height-chest circumference. The difference between the first two increase with age up to about 35 years, between the latter two up to about 21 years.

(2) Below about age 10 years, and as far back as the investigation has gone, i.e., 6 years, the correlations of height and weight, and height and chest circumference, retain the relative positions they show after 10 years. But at about that age the trends of the correlation of weight-

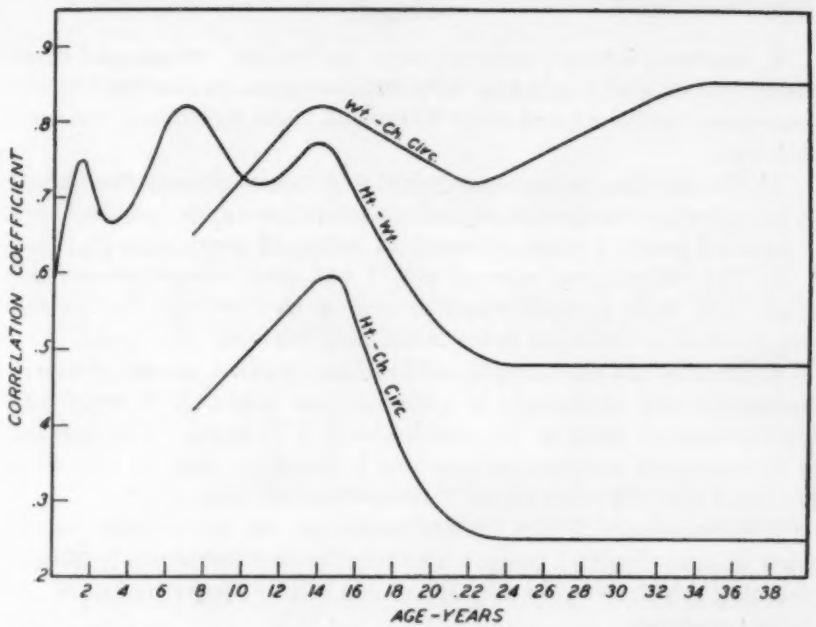

FIG. 18. COMPARATIVE LEVELS, CORRELATION TRENDS ON AGE, HEIGHT-WEIGHT, WEIGHT-CHEST CIRCUMFERENCE AND HEIGHT-CHEST CIRCUMFERENCE

chest circumference and height-weight cross because of a change in direction of the height-weight trend. From this results the fact that from 6 years to 10 years the height-weight correlation is higher than the weight-chest circumference correlation.

I believe that this summary gives the comparisons that are to be considered the most probable on the basis of the available data.

It is to be noted, however, that the continued downward slopes observable as the trend is followed backward from fourteen years in both the weight-chest circumference and height-chest circumference correlations were determined without any knowledge of these correla-

tions under 6 years. It is possible, and indeed there is some slight evidence in the data pointing that way, that were values under 6 years available a change in direction in the trend, comparable to that found in the height-weight correlation at 11 years, would be discovered. I doubt, however, that the age point of this change would be such as to affect the comparative levels of the correlations as they have been summarized above.

SUMMARY

1. Intercorrelations between height and weight, weight and chest circumference, and height and chest circumference, as measured by the Pearsonian coefficient r in male whites, all show significant variation with age.

2. The correlations between height and weight show in their trend on age alternate maximum and minimum points in the neighborhood of ages 1.5 years, 3 years, 6 years, 11 years, 14 years, and 21 years.

3. The correlations between weight and chest circumference, and height and chest circumference, as well as that between height and weight, show a maximum point in the neighborhood of 14 years.

4. Each of the other statistical functions studied, means, standard deviations, and coefficients of variation, also shows in its trend with age a maximum point in the neighborhood of 14 years. This is taken to be associated with adolescence and I, therefore, refer to the fall in the trend after 14 years as the "post-pubescent decline."

5. Comparison of the critical points of the correlation trends, other than at about 14 years, with those of other statistical functions, including velocity of growth of the means, shows suggestive but inconclusive analogies.

The relative size of the correlation coefficient after about 10 years is highest for the weight-chest circumference, next for weight-height and smallest for height-chest circumference. Between the ages of about 6 years and 10 years, the height-weight correlation coefficient is higher than the weight-chest circumference while the latter and height-chest circumference retain the relative position they occupy after 10 years.

APPENDIX

I. Determination of Correlation Coefficients for Sample I

The original data of this series were not obtainable, and in the published report by Woodbury ⑥, they were not tabulated in such

form as to permit the calculation of the coefficients by the methods ordinarily used. Advantage was taken of the tabulation on pages 32 and 33 ⑥ to obtain the desired statistics as follows:

The tabulation referred to gives for each yearly age group between one and seven years, and for finer age groups below one year, the mean weight for specific statures by inches, and also the number of individuals in each group. Straight lines were fitted by least squares to the weighted means vs. height in each age group separately tabulated. If the slope of this line be M_a then the correlation is given by

$$r_{hw.a} = \frac{\sigma_{h.a}}{\sigma_{w.a}} M_a$$

where

$r_{hw.a}$ = correlation between height and weight at age a
$\sigma_{h.a}$ = standard deviation of height at age a
$\sigma_{w.a}$ = standard deviation of weight at age a

$\sigma_{h.a}$ was calculated for the various age groups from the corresponding monthly σ's given on pages 18 and 19 by the following formula

$$\sigma_{h.a} = \sqrt{\frac{n_1(\sigma_1^2 + d_1^2) + n_2(\sigma_2^2 + d_2^2) + \cdots}{n_1 + n_2 + \cdots}}$$

in which

$\sigma_{h.a}$ = standard deviation of height for age group a
$\sigma_1, \sigma_2 \ldots$ etc., are the standard deviations for the monthly groups contained in age group a

d_1, d_2, etc., are the several distances between the mean height for age group a, and those for the constituent monthly age groups.

n_1, n_2, etc., are the numbers in the several monthly groups.

$\sigma_{w.a}$ was calculated from the similar formula for weight.

II. Effect of Age Grouping on σ and r

Since it was desired to evaluate r and σ at fixed age points, it was necessary that age be kept constant for the individual determinations. Literally, this is impracticable, since it would require that the individuals comprising each group be of identical age. The alternative is to use age groups of sufficient refinement to warrant the assumption that age is "practically constant." To do this one must be able to estimate the effect of age grouping on the statistics in question. I have developed a formula for this which I give in the following, and it is

on the basis of this solution that the statement on a previous page was made."... the age groupings used were fine enough to insure the conclusion that the age trends obtained were the same in their essential characters as would be gotten with greater refinement of grouping."

(a) Effect on σ

Let y be the variable involved which varies with a, the age.

Let A be the interval of the age grouping.

Let m_a be the amount of change of y during the age interval A.

Let $\sigma_{y.a}$ = the instantaneous standard deviation of y during the age interval A. It is assumed that during the age interval A the regression of y on age is linear and that $\sigma_{y.a}$ is constant. Then

$$\sigma_{y.a} = \sigma_y \sqrt{1 - r^2_{ya}} \tag{1}$$

σ_y = the standard deviation of y for entire age interval A.

r_{ya} = the product moment correlation of y and a.

It may be shown that

$$r_{ya} = \frac{\sigma_a}{\sigma_y} \frac{m_y}{A} \tag{2}$$

where

σ_a = the standard deviation of a for the interval A.

Now

$$\sigma_a^2 = \frac{\int_{-A/2}^{+A/2} (yda)a^2}{\int_{-A/2}^{+A/2} yda} = \frac{A^2}{12}$$

Substituting in (2)

$$r^2_{ya} = \frac{m_y^2}{12\sigma_y^2} \tag{3}$$

Substituting in (1)

$$\sigma^2_{y.a} = \sigma_y^2\left(1 - \frac{m_y^2}{12\sigma_y^2}\right) = \sigma_y^2 - \frac{m_y^2}{12}$$

(b) Effect on r

Let r_{xy} = the correlation between the variables x and y grouped in age interval A.

Let $r_{xy.a}$ = the instantaneous correlation between x and y during the interval A.

Assume that during the interval A the regressions of x and y on age are linear.

Then

$$r_{xy.a} = \frac{r_{xy} - r_{xa}r_{ya}}{\sqrt{1 - r^2_{xa}}\sqrt{1 - r^2_{ya}}} \tag{4}$$

As in (3) above

$$r^2_{xa} = \frac{m_x^2}{12\sigma_x^2}$$

$$r^2_{ya} = \frac{m_y^2}{12\sigma_y^2}$$

in which

m_x is the change of x during A.
m_y is the change of y during A.

Substituting in (4)

$$r_{xy.a} = \frac{r_{xy} - \dfrac{m_x m_y}{12\sigma_x\sigma_y}}{\sqrt{1 - \dfrac{m_x^2}{12\sigma_x^2}}\sqrt{1 - \dfrac{m_y^2}{12\sigma_y^2}}}$$

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To the writings of the Director of the Institute for Biological Research, Raymond Pearl, I owe the inception of my interest in the method of biometric analysis, to the continued stimulus of his personal example, the determination to pursue this method in the furtherance of scientific research, and to the experience gleaned while assisting in one of his investigations, the specific suggestion of this research.

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NATURAL SELECTION IN THE PROCESSES OF POPULATION GROWTH

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Scripps Foundation for Research in Population Problems, Miami University

There is a very wide-spread feeling that natural selection is a process which exists in a *state of nature* determining the survival of plants, animals, and even of man up to a certain stage of cultural development, but that it has been replaced by a more controllable, less rigorous process in the highly civilized organization of society developed in the Western World. Just when natural selection was supplanted by what may be called artificial selection—for the sake of contrast, in the development of the United States for example—we are never told, but one may surmise from the writings of many eugenists and pseudo-biologists that the development of medical science and practice within the last half-century has gradually nullified the action of natural selection until today artificial selection, that is, selection controlled by man's interference with *natural* processes, is the chief factor in determining who shall survive. Furthermore, it seems to be very commonly assumed that natural selection was, and where existing still is, a process biologically beneficial to the race while artificial selection as now operating is a process of questionable value. The former killed off the weak and inferior while the latter preserves them and allows them to propagate with great rapidity.

The questions that arise in this connection in the mind of one studying the processes of population growth are whether there is any valid ground for calling the processes of selection *artificial* today as contrasted with *natural* yesterday; whether the processes of selection going on today are any less rigorous than they were yesterday; and whether they are less eugenic now than formerly.

SELECTION NO LESS NATURAL NOW THAN FORMERLY

The answer to the first question, as to whether there is any real difference in the character of the processes called natural and artificial,

seems to me to be, *no!* There has never been a time in the history of man when his habits, his customs, and his efforts to avoid discomfort have not been important factors in determining his survival. He has always to a greater or lesser extent modified his environment in the effort to adapt it to his desires, and he has also modified the action of environment on himself by his habits, customs, institutions, etc. The selective processes in the life of the race have always been artificial or they have never been artificial. Every process in human selection has always had in it elements contributed by man. In this respect it is no different today from what it has always been. It is no less natural now than it was when our ancestors were forest-dwelling barbarians or than it is today among the Dyaks of Borneo.

The low death rate of today, which seems to be the chief indicator of artificial selection in the minds of many people, is not a whit more artificial than scores of customs among so-called primitive peoples which affect the birth and death rates among them. Just as soon as any habit or custom becomes fixed in the life of a group it is as much a part of the processes of natural selection as any circumstance not directly under man's control. The intense cold of the Arctic winters is not a whit more natural, in any significant sense, than the communal customs existing among the Eskimos. Survival is no more dependent on adaptation to the former than to the latter.

The point I would insist upon here is that natural selection as ordinarily used in referring to the processes of selection in man is just as applicable to the processes going on today as it was to the processes of a generation ago, a century ago, or a millenium ago. There has been, of course, some change in the working of these processes, but they are still as *natural* as they have ever been. They may or may not be beneficial from the standpoint of any particular social group. There is not now and there has never been any assurance that the types of man most honored by their fellows will have the greatest survival value.

Natural selection is based wholly upon the survival value of the traits possessed by the individual. The traits surviving in any group, animal or human, may or may not be the best or most desirable depending upon the point of view from which they are judged. But the selection for survival going on among men is always *natural* in the sense that it is the necessary consequence of the given conditions.

HOW RIGOROUS IS SELECTION TODAY?

Supposing then that we drop the distinction often made between natural and artificial selection and regard all the processes as natural in the circumstances under which they operate. Is there any reason to suppose that these processes are less rigorous today than they were ten centuries ago? In a considerable part of the world they have changed but little in ten centuries, and so, of course, are of the same kind and intensity as of yore. Therefore, in attempting to answer this question, we need not consider the regions and peoples where there has been but little change. In Western Europe, North America, Australia, South Africa, Japan, parts of South America, and a few other places great changes in modes of living have taken place recently. The last century and a half has seen momentous changes in the lives of several hundreds of millions of people. Have these changes lessened the rigor of the selective process to which these people are subject, and have they resulted in the selection of the poorer stock for survival? In other words, have our changed conditions of life issued in a process of natural selection more favorable to the survival of less desirable human types?

Before we can give a plausible answer to these questions we must be certain that we understand what *rigor* in natural selection means. Many people seem to think that natural selection is not as rigorous today as formerly merely because our death rate is only one-third to one-half as great as of yore. This one fact seems to them to prove that the rigor of the selective process has been greatly abated of late years. The simple fact is, however, that all people must die and in the process of evolution it is of little significance whether the individual lives, provided his traits are carried on. The rigor of the selective process is to be judged, then, not by the height of the death rate, but by the proportion of the population of the succeeding generation that springs from each of the different groups that make up the present generation.

Judged by this standard, it seems probable that natural selection is now more rigorous than ever before. It is probable that more strains of family stock are now dying out in a generation or two than in most past ages; also that certain groups in the population which are not dying out quite so rapidly are producing a smaller proportion of the next generation than they themselves constitute of this.

Detailed proof of the great rigor of present day natural selection cannot be given here. There is no doubt, however, in the mind of

anyone familiar with the processes of population growth in our own country and in Western Europe, that a very considerable part of our population is failing to reproduce itself. This means that natural selection is operating with extreme rigor. We may secure some notion of the degree of rigor from the fact that in England and Wales in 1911 the least fertile quarter of the marriages of completed fertility produced only 2.1 per cent of the births, and the least fertile half produced only 17.7 per cent of the births; while the most fertile tenth produced 24.8 per cent, and the most fertile fourth produced 52.0 per cent of the births.[1] In this same study, it was found that slightly over 16.0 per cent of all marriages of completed fertility produced no children. Clearly the selective process is extremely rigorous in the industrialized community of today; although we should note that the failure of a rather large proportion of a population to leave any children does not necessarily mean the extinction of the traits carried by them, for in many cases there will be other members of the same family who are reproducing. Thus the rate of extinction of family traits is by no means as rapid as the failure of individuals to reproduce might lead us to suppose. The processes of natural selection are, then, very rigorous today in industrialized communities. It is a mistake to suppose that they are more rigorous in China and India and other backward communities where machine industry has made but little headway.

HAS THE EUGENIC CHARACTER OF SELECTION CHANGED?

But, granting that this is the case, it will be said that the processes of selection going on among us are calculated to make the survival of undesirable types easier than among the backward peoples; that formerly the differential death rate removed the ne'er-do-well, the defectives, the incompetents, the vicious, and the poor at a much more rapid rate than the successful, the rich, and the powerful; and, that as a result of this process, the race has, in the past, grown more largely from the middle and upper classes, who were of superior stock, than from the lower classes, who were inferior in ability.

It is by no means certain, however, that the processes of selection were as simple and certain as this view implies. In the first place, it is rather doubtful whether the upper classes did actually increase much

[1] *Census of England and Wales*, 1911. Fertility of Marriage. Part II. Pp. xlvii.

more rapidly than the lower classes, and in the second place, it is rather doubtful whether the upper classes (by which is generally meant the upper economic classes) were and are the all-round superior type of human being upon whom the progress of the world depends. With regard to the higher survival rate of the rich and powerful in past times, a few considerations may be set forth which will make it appear less axiomatic than is generally assumed.

One of the chief occupations of the upper classes in most communities in past times has been war. And it should be borne in mind that in many nations this occupation was reserved exclusively for the upper classes. The peasants and the laborers were only indirectly involved in it. It is exceedingly questionable whether this fact alone is not sufficient to counteract the greater incidence of non-violent deaths upon the lower classes, if indeed this incidence was greater. But in addition to the losses from fighting, upper classes always and everywhere have been inclined to debauchery. There appear to be but few people who can withstand the debilitating influence of wealth and leisure. Debauchery shortly results in the dying out of the family. A study of European nobilities shows that in the legitimate line they are not very long-lived. Even in China, where family ties are unusually strong, the powerful and exalted are corrupted and disappear within a few generations. From these two considerations alone, it would appear doubtful whether in the past, the race has actually been bred so much more largely from the upper classes as is commonly assumed. But we must also recognize that in times past, the quick-acting germ diseases; small pox, typhus, typhoid, diphtheria, plague, etc., were the causes of a very considerable proportion of all deaths after infancy was past, and that these diseases were but indifferent respecters of social status. They must have made but little distinction between the mighty and the lowly in ages when they were regarded as inevitable visitations of the wrath of God. Even in the incidence of infant mortality, there can not have been a very great difference between the hut and the castle, for the first principles of sanitation were utterly unknown in both places.

Furthermore, when we find that much the same differences in death rates between the upper and the lower classes that are supposed to have existed in former ages still exist,[2] we may very legitimately question

[2] The latest comprehensive occupational mortality data I have been able to find show that in England and Wales in 1921 upper and middle class males at ages 25–34 had a death rate of 261 per 100,000 while unskilled workers of the same

whether the processes of population growth as affected by the death rate are very greatly different today from what they have been for some centuries past. The easy and frequent assumption that, until recently, the processes of natural selection, operating chiefly through a differential death rate, were eugenic in nature, but that recently they have become dysgenic, seems to me to be scarcely borne out by what we know of the incidence of death in the past. I am inclined to believe, when all facts of survival are taken into account, that the so-called common people have always furnished a larger proportion of each succeeding generation than they themselves constituted of their own generation. If they are gaining in the proportion of the succeeding generation which they furnish today, it is not because death is relatively more kind to them than to those in preferred social positions, but rather that the differentials in birth rates between classes have become greater of late years.

THE DIFFERENTIAL SURVIVAL RATE

In order, then, to form any adequate notion of whether human stock is deteriorating, owing to the processes of natural selection operating today, we must very briefly outline the processes of actual growth and see if we can discover any tendency in them. Stated very briefly, these processes may be summed up as follows:

(1) When our population is divided into the two groups, urban and rural, it is the rural which has the higher survival rate. Of different groups in the rural population, the farmers have larger families than the villagers (business men, artisans, and laborers), and among farmers the foreign-born have somewhat larger families than the native-born living in the same parts of the country. Also the less industrialized an area is, or conversely, the more rural an area is, the larger are the

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age had a death rate of 498; at ages 35–44 the rates were 484 and 880 for upper and middle class, and unskilled workers, respectively. Throughout the range, 20–65 years, the death rate of unskilled workers was about fifty per cent in excess of that of the upper and middle classes, but is much greater than that, as the figures just given show very clearly, at the ages when reproduction is taking place. It simply is not true that modern sanitation and medicine have made the chances of survival as good for the poor as for the well-to-do. In fact, it is extremely doubtful whether their relative positions have been much changed by modern sanitation and medicine. (See *The Registrar-General's Decennial Supplement. England and Wales.* 1921. Part II. Pp. 3–5.)

families (in the South, farmers' families are larger than in the North). (2) When the urban population is divided into groups, we find that there is a distinct difference in the rate of survival between those in the white collar jobs and those in overalls. The former *as a group* are dying out, although about 60 to 70 per cent of those who have children are surviving and adding to their numbers (that is, they have three or more children). As between the native stock and the foreign stock in our cities, the former *as a whole* is little more than keeping up its number, if indeed it is doing that, although probably not far from 70 to 80 per cent of those who have children have three or more. The foreign-born, on the other hand, have quite large families generally, so that by far the greater part of the excess of births over deaths in the cities comes from the foreign-born. Within the white collar class there also appears to be some difference in the size of family in different occupations. Probably clerical workers have smaller families than professional workers, and professional workers slightly smaller families than tradesmen. Those who have an assured position and considerable wealth probably have a larger number of children per family than any other group in this class.

ARE THE LOWER CLASSES INFERIOR?

Whether or not the processes of growth just indicated are sufficiently different from those of the past to cause us uneasiness will necessarily remain a matter of argument, because no proof of a definite trend exists. When I consider that by far the larger part of our increase is coming from farmers, immigrants, and the poorer-paid industrial workers, who are the children of either farmers or immigrants, I find no cause for worry as to the quality of the next generation. I cannot find any proof that these people, as a group, are lacking in the qualities out of which a far better social order than we possess today might be built. I am totally unconvinced by the results of the so-called intelligence tests, by the fact that they have lower standards of living, by the citation of the crime records of the children of immigrants, and such other *proofs* as I have come across that there is any essential inferiority in the classes which are now contributing most to the next generation.

It seems to me that the only inferiority proved by these demonstrations of differences between the privileged and the unprivileged classes is that arising from lack of opportunity.

I am quite ready to believe that children reared under conditions where their opportunities are very limited are unable to answer a given set of questions as correctly as children who have had larger opportunity to learn the answers and who have been encouraged by their parents to learn all they can. But this is no proof of hereditary inferiority or superiority. It is merely proof of differences in opportunity. The same is true of differences in standards of living. It is no proof that a person is hereditarily deficient when he prefers to accumulate a certain amount of money rather than to spend this money to live better. It is merely proof that his scale of values is different from that of those who prefer to spend their incomes on current expenses rather than to save them. So it seems to me that it is with comparative crime records and the other *proofs* of the inferiority of the classes which are providing a large part of the next generation. They are merely proofs of differences of social status and not of basic hereditary differences. I am not, of course, denying that there are feeble-minded, epileptic, insane, and otherwise incompetent people in our population, nor that they are relatively more numerous in some classes than in others, but I object to generalizing and saying of *whole* groups and classes that they are hereditarily inferior when all we have proved is that they have not had the same chance as other groups or classes.

ARE THE UPPER CLASSES SUPERIOR?

At the same time that I do not consider the *proofs* of the inferiority of the rapidly reproducing groups satisfactory, I do not consider the *proofs* of the hereditary superiority of the socially successful satisfactory. Social success, in which I include economic success, is proof only of individual adaptation to the conditions necessary to secure the type of success which happens to be valued most highly by the group at a given time. It is not proof of an all-round ability in the person who succeeds, nor is it proof of the possession of qualities which will contribute largely to the development of a progressively improving society. As a matter of fact, many people who make a social success do so because they are thick-skinned and lack the imagination to see the ways in which their success will react adversely upon the welfare of others and upon the organization of community life. There is nothing inherent in the nature of social success to insure that the person who attains it will also possess the finer human qualities which will add to the fullness and richness of our life.

It would not be at all difficult for any one who knows a number of successful people to pick out several of them, perhaps one-tenth to one-fourth, who owe their success largely to the qualities which they share in common with the bully, the prize-fighter, the ward-heeler, and the fox. There is not time or space to go into the nature of the social processes selecting people for success, but no one can study the people who attain a little more income and prestige than the average without feeling that a considerable proportion of them (perhaps one in four or five) have attained their position by the exercise of entirely specious qualities or by manipulating common human weaknesses for their own enrichment and aggrandizement. In other words, an appreciable proportion of the socially successful owe their success to their rather dull moral sense; for they see nothing out of the way in exploiting their fellow men as long as they can avoid unpleasant legal consequences. Can it be seriously contended that such people are the salt of the earth, and that their failure to reproduce is a serious loss to the community?

The more I study the processes by which the socially successful arrive, the less certain I am that the community suffers irreparable loss if a considerable proportion of them fail to reproduce. The processes of selection we now employ seem to me so ill-adapted to secure the ascendency of the finer types of intellect and character that I often wonder how it happens so many fine people do attain success rather than why there is a large minority of rhinocerous-hided dullards and crafty schemers who also attain success. If society really wants the *best* and the *successful* to be one and the same group, it must give a great deal more attention than it ever has hitherto to the social processes by which the successful are selected. These processes will need much overhauling before they can be relied upon to bring to the top unerringly those persons who have the greatest value from the standpoint of enlarging the opportunities of all men for the living of a complete life.

In view of this great imperfection of the processes selecting the successful, I see no reason to be greatly concerned over the quality of the race, even if a considerable proportion of the successful are dying out. The good qualities of the race are not at present so exclusively the possession of any one group or class that its dying out will seriously impoverish future generations.

Furthermore, we do not know that the rates of growth are the same for all types among the successful. There is some reason to

think that those who take their success seriously and honestly endeavor to give society value received in return for its recognition raise larger families than those who regard the world as "mine oyster" and are concerned chiefly with cracking it to secure the meat. It is the latter type we may well spare. There will always be too many of them in the world.

THE DESIRE FOR CHILDREN AS A FACTOR IN SELECTION

But even if we grant, for argument's sake, that the present processes of natural selection, which result in the rapid dying out of a goodly portion of the successful, are dysgenic, there is no reason to suppose that they will remain so for any great length of time. The present differentials in the birth rate are readily understandable in the light of the facts regarding the spread of birth control knowledge. When this knowledge becomes universal, as it probably will be among our children, and when the inhibitions against putting it into practice are largely removed, as they will be among our children also, then we may find that the present processes of population growth will be considerably changed. It is not at all inconceivable that as the size of the family comes more and more under control, the differential birth rate will come to express real differences in outlook upon life. When this comes to pass we may reasonably expect that those people who see some meaning and purpose in life and who wish to contribute their mite to the development of this meaning and purpose will be ready to make considerable personal sacrifices to leave children to carry on. Personally I should regard cherished desire to participate in the future through their children as far better proof of desirable qualities than any of the processes now at work for selecting the successful and should hope that when the population is largely sprung from such people, the world will be a better place to live in than at present. Up to the present, the combative, acquisitive type has played altogether too large a rôle in the development of our ideals and our forms of social organization.

Already, there is some evidence that a change in the processes of population growth is under way, and that the present differentials may not long endure. Huntington and Whitney[3] have found that among Yale graduates those who are judged the more all-around successful by their classmates have larger families than those who are adjudged less successful. They also state that Dr. Phillips found

[3] *Outlook*. September 7, 1927. Pp. 21–23.

the same to be true of Harvard graduates. In Stockholm, Dr. Edin[4] found that the fertility of marriage was less among the working classes than among the professional and well-to-do classes, and among the latter it was greater as the income was larger. This is contrary to the findings of most studies in differential fertility, but there is every reason to think that it is correct for the population under consideration. It is also easily understandable that this should be the case in a population where practically every one knows about and practices birth control as he sees fit. These facts indicate new tendencies in population growth which are not unlikely to become general as the knowledge and practice of birth control become universal among urbanized and industrialized populations. The author has found evidence of a similar tendency in the lowest social class in our northern cities—the negroes. They appear to have the lowest rate of effective fertility of any group that can be clearly identified from the census returns. It seems not altogether improbable, then, that the processes of growth described above and which are common to most, if not all western peoples at the present time may change considerably in the near future as the knowledge and practice of birth control spread to all classes in the community.

Now, I do not pretend that I have answered categorically the question whether the processes of natural selection as manifested in the differential growth of the various groups in our population are working towards the improvement of our stock or for its deterioration. But I do believe that the considerations adduced above show that we need not be greatly concerned over the biological consequences to the nation resulting from the present tendencies in the growth of our population. Long before they have issued in any appreciable change in our racial quality, they will have changed so much that we shall be confronted with an entirely new situation. Whether in this new situation natural selection will be more or less favorable to the maintenance of race quality than at present, we cannot, of course, tell; but I have just indicated my belief that the earnest desire to participate in the future through one's children may be a potent factor in determining survival. If this should come about, I certainly believe that we shall have a more satisfactory type of natural selection than we now have, even though I do not believe that our present type is nearly as unsatisfactory as the eugenists make out.

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[4] Karl Arvid Edin: "Fertility in Marriage and Infantile Mortality in the Different Social Classes in Stockholm from 1919–22." *Proceedings of the World Population Conference.* Pp. 205–7.

COMPULSIONS, OBSESSIONS, AND FEELINGS OF UNREALITY*

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If a large number of healthy persons could be carefully examined it is probable that compulsions, obsessions and feelings of unreality might be found to occur among them far more frequently than is now known. It seems to be common practice for children to have compulsion-like tendencies to step on cracks of the sidewalk, or to avoid them, to touch posts or pickets of a fence, to count, to sing the same tune for long periods, or to think of the same word or phrase many times without adequate reason. Sometimes games are played in which order, system, and neatness give more than ordinary satisfaction. Repetition is a method employed by most children in learning a school lesson. Indecision and hesitation are seen frequently during play and school life. Fears of various kinds may be prevalent, but especially those of darkness, of heights, of being left alone, of strange persons or animals, of punishment, of storms, and of diseases. By early adult life most of these fears and other tendencies have ceased, or exist only as vestigial persistences which do not annoy or distract but are part of the phenomena of life. In an occasional person such fears and the defenses against them (probably more pronounced from the beginning) are outstanding and may become specialized, to recur at certain times or places, thus to annoy and undermine ability and happiness of the person. Physicians are likely to see only those interfering with the patient's welfare and have little occasion for observing persons who under certain circumstances are obsessed by thoughts and feelings which may be somewhat satisfying and even helpful to them.

Some persons who work too intensely or too long with numbers, colors, or names find them to recur even in their sleep with annoying persistence. Students of ethnology[1] have described tribal ceremonies and rituals that closely resemble compulsions and obsessions. The

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similarity of some of these customs in different parts of the world is so striking as to suggest that they originate in the same biologic impulses. Superstitions seem to be related to obsessions and compulsions. One must not overlook (and this does not necessarily render the situation hopeless) a certain type of heritage which often begets both the environment and the protoplasm conducive to such psychopathologic disorders. As the child becomes a man, the urge for food, drink, sleep, rest, comfort, progress, state of being like his fellows, and gratification of the sex instinct must be socialized and conventionalized. Compulsions and obsessions are among the anomalies of this transition.

THE MECHANISM OF COMPULSIONS AND OBSESSIONS

Greenacre has made an analysis of the mechanism of compulsive-obsessive states, which she believes have their inception in the conflict between desire and fear. She believes that in some patients symbols and substitutions have replaced the original fears and desires. These explanations seem plausible. However, if these conditions prevail, which is likely, in patients who have no compulsions and obsessions, one is forced to inquire more specifically into the kind of person in whom they are more prone to develop. Consideration of the forces which may conspire to bring them about prompted this study.

An obsession is a state of being besieged by an idea, thought, memory, or feeling which recurs in spite of the better judgment of the patient. A compulsion or imperious act (mania of Janet) is a purposive act or inhibition over which the patient seems to have little, if any, control and which is usually contrary to the patient's reason. A compulsion often affords relief from an obsession. Feelings of unreality are affective or emotional states in which the environment or the patient's body seem unnatural despite actual knowledge to the contrary. There are also the somewhat different feelings of marked deficiency or inadequacy usually applied to the patient's own worth or capacities. Patients are often obsessed by such feelings. In persons suffering from obsessions and compulsions, reason and knowledge seem more or less divorced from feelings and action.

My experience, during the last four years, with thirty-six patients having compulsions, obsessions and feelings of unreality, forms the basis of this study. Sixteen were men and twenty were women. The average age in this series was twenty-eight; the youngest patient was aged sixteen years and the oldest, fifty-six. In only a few was it

impossible to elicit some peculiarity of early childhood, which although not considered significant in childhood, might seem to be of significance in the light of subsequent developments. Instability or inadaptability of varying degree was found in the immediate family or collateral branches of thirty of the thirty-six patients. In many cases the parents of these patients were of extremely different temperaments. It seems significant that seven of the patients were teachers, in whom an exaggerated craving for order and neatness was gratified as well as aggravated by certain aspects of school life.* A variety of somatic complaints were made by the various patients in the series, but headache, strange sensations in the head, and abdominal distress predominated. One patient had diabetes mellitus; one, a fracture of the vertex of the skull; one, a cerebral birth injury; one, a moderately low basal metabolic rate, and one, chronic empyema which required operation. Evidence of a previous attack of epidemic encephalitis was not present in any case in this series.

There is reason to believe that the metabolic and physiologic processes in some of these patients are unusually disturbed at times. It is these physiopathies which engage almost the entire attention of the general practitioner of medicine and unless he has had experience with compulsive-obsessive disorders, he may draw erroneous conclusions about the patient and misdirect treatment.

CASE HISTORIES

The following cases illustrate facts associated with the development of compulsions, obsessions, and feelings of unreality.

Case 1.—A man aged thirty-three years, a student for the priesthood, came to The Mayo Clinic to seek relief from pressure headache and nervousness with which he had been troubled most of his life. His four brothers were excessive users of alcohol. His home life was very unpleasant. As a child, he had feared many things. School work had been difficult for him. He gained comfort and solace in church and early decided to become a priest. He worked arduously at his studies to that end, only to become "nervous," by which he meant an obsession "to be truthful and do right things" which compelled him to go often to his father confessor. He also had a dread fear of syphilis, to protect himself against which he washed his hands many times a day, and took other precautions. He repeatedly indulged in these time-consuming tasks against his better judgment. He experi-

* It is said that occasionally the obsession of order, rhythm and neatness is highly developed in instructors in military academies.

enced short episodes of depression and was very restless and tense at all times. Because of his scrupulosity and his fear of contamination he could not pursue his studies, which gave him grave disappointment and made him seek medical aid from many sources. Among other remedies he tried many kinds of employment without help or success. Hallucinations were not elicited. Except for excessive muscular tension and inability to relax, the general examination did not elicit anything definite.

Summary.—A student for priesthood, always fearful and from an unstable and unhappy family, had pathologic scrupulosity and ideas of contamination which interfered with the desire of his life and disappointment resulted.

Case 2.—An obese man aged thirty-seven years, married and a salesman, sought relief from nervousness and heart trouble. He was the only child. His father had died of heart disease. His mother always had been much afraid of diseases and protected him excessively. Hereditary obesity occurred in the family. In early life, because of his seriousness, he was teased much by other boys, and was the victim of many jokes. He was considered fussy; he liked to count objects, especially spots on wall paper. He found it difficult to make decisions. As a boy he had been horrified at seeing a man drop dead of heart disease. While in the army he fainted after a march, and a physician spent much time examining his heart and kept him in bed for several months. He once overheard a physician discussing "tobacco heart;" he had used much tobacco all of his life. Soon alter he was discharged from the army he became conscious of his precordium and at times felt somewhat faint. He associated these sensations with heart failure, the dread oi which soon obsessed him perpetually. He had twinges of depression. He moved about vesy slowly and quietly. He was obsessed by a crowd but wos equally worried by being left alone; he preferred to have his mother or his wife with him. He could not work. He had learned that alcohol allayed the dread and thus he had become a chronic addict to alcohol. General examination revealed only vasomotor instability and obesity.

Summary.—A young man, nurtured in the fear of disease, and especially of heart disease, was compelled to relieve an obsessive dread of dying of heart failure by using alcohol and became a chronic alcoholic habitué.

Case 3.—A married woman aged thirty years, formerly a teacher, complained of nervousness which had been bothering her for about two years. As a child she was said to have been "spoiled," and was afraid of many things, among which were diseases. She associated with persons much younger than herself. The members of her family apparently were well and stable. At the age of twenty-one years she had had a severe respiratory infection during which she was very delirious. She did not recover from this illness well and chronic empyema of the left part of the chest soon was found. On several occasions in the next eight years, this required drainage by thoracentesis. Thoracectomy was done when she was twenty-nine; she recovered well from the operation but gradually grew more tense, restless, depressed, and became obsessed by the idea that she would catch cold. Her processes of thought were very rapid. She knew not what to do or where to go to keep from catching cold. Associated with this obsession a marked feeling of tension developed which came to crises, and which she relieved by suddenly throwing a dish to the floor, or violently tearing to pieces any garment she might be wearing. She admitted that the obsessions and compulsions seemed

absurd but that she could not free herself from them. She lost 20 pounds and slept poorly. She recovered completely within three years from the onset.

Summary.—A young woman given to fear in childhood, after an operation for drainage in chronic empyema became obsessed by the fear of catching cold, became depressed and restless, and had crises of tense feelings which were relieved by breaking dishes and tearing clothing from her body. She recovered.

Case 4.—A single woman aged twenty-four years, a teacher, complained of nervousness which had annoyed her for about a year. She stated that in her childhood she often had been obsessed by a tune, and was annoyed by any disarrangement about the house, such as pictures hanging crookedly or rugs or chairs out of their accustomed places. She was annoyed by dirt. Aside from these peculiarities she appeared to be entirely well until, on awakening from a nap one after noon, nothing in her home seemed real. Although her surroundings appeared much the same as usual, they did not mean to her what they had meant before and she felt herself in a strange world trying to get back to familiar sights and scenes. The unreality obsessed her at all times and recurred against her better judgment. It was on account of these that she sought relief. She was occasionally moderately depressed for periods of less than an hour. She was tense and restless and found it difficult to work. On further inquiry it was found that her mother had experienced a similar attack earlier in her life and had recovered completely. Her elder sister had experienced feelings of unreality for an afternoon at the age of sixteen years. The patient had had a similar attack when she was fifteen years of age which had lasted for a few hours. Hallucinations were not elicited. Except for excessive dreaming she slept well and had not lost weight. General examination was essentially negative.

Summary.—A young woman had recurring attacks of feelings of unreality. Her mother and sister had recovered from similar attacks.

Case 5.—A woman aged thirty years, divorced and a factory worker, sought aid for a peculiar type of nervousness which had bothered her in attacks since the age of fourteen years. A sister had convulsive seizures and her father was said to be nervous. Nothing exceptional about her life prior to the age of fourteen years was elicited. Between the ages of fourteen and fifteen, of twenty-one and twenty-two, and after twenty-nine, she had been grievously annoyed by strange thoughts and feelings. She stated that in these attacks she was annoyed by a feeling that her mother's head, detached from the body, was always near her. At times, when drinking warm milk she felt that it was her mother's blood. In wringing the water from a dish rag she often had the feeling that it was her mother's neck. These grotesque obsessions annoyed her greatly and to get relief from them she went to a state hospital twice as a voluntary patient. She was not depressed. She stated that she had lived happily with her mother all her life except for a short period of married life that had lasted from the ages of twenty-one to twenty-two; during her married life her mother-in-law treated her unkindly. She left her husband and never returned to him. She did not blame her husband for the unhappiness. Her better judgment told her the obsessions were not true but she could not keep them from annoying her. She declared that if her mother had not been so good and kind to her the obsessions might have had some justification but their lack of basis in fact annoyed her all the more. General examination gave negative results.

Summary.—A woman aged thirty-two years had recurring attacks of being obsessed by the presence of her mother's detached head, of drinking her blood or wringing her neck. She was not depressed.

Case 6.—A married man aged forty-one years, a cashier, complained of fear of suffocation which had been present for six months or more. His mother was nervous and his sister had had a nervous breakdown. The patient, from early childhood, had had a dread of tuberculosis which he believed he had acquired when some of the members of a family near his home died of the disease. He had had attacks almost like the present one at the age of twelve years, for six months; at sixteen, for six months; at twenty-three, for eight months, and at twenty-eight, for eight months. He attributed recovery at the age of twenty-eight years to the surgical removal of the thymus gland. His wife stated that when well he was very efficient and meticulous, that he seemed to be irritated unless her house was in the most orderly fashion, and that his office was arranged with great care. At the onset of attacks he became somewhat tired and depressed for a few hours at a time and soon became obsessed by a fear of suffocation which compelled him continually to try his breathing apparatus to see if it was functioning. He thus presented the appearance of a patient with severe dyspnea. He would become very restless at times. His tendencies to be obsessed by order in his home or office subsided during attacks. He slept poorly, lost 40 pounds, and at times was panicky. He had not had encephalitis. The results of general examination, except for loss of weight, were negative.

Summary.—A man aged forty-one years, who had always feared tuberculosis had recurring attacks of being obsessed by fear of suffocating which compelled him continually to try out his breathing mechanism by rapid hard breathing.

Case 7.—A married woman aged thirty-six years complained of nervousness of several years' duration. She had always been quiet and retiring. Her husband had noted that she was always meticulously clean and orderly about her home. She had always been devoted to her church; for several years she had been praying more than usual. She became so exhausted that she could no longer do her work. This led to medical examinations which disclosed diabetes mellitus. Treatment for this did not change her general state of nervousness. Her housework became a ritual. She washed her hands frequently. She stated that her neighbors had been good to her but in her conversations with them she had felt that she told them some falsehoods or made evil statements, and she prayed to relieve her feelings incidental to such obsessions. The cleaning and washing of hands also satisfied a desire to purify herself and be what she should be. She did not have hallucinations and she was depressed only for short intervals. The examination revealed moderately severe diabetes mellitus and dental infection. Blood pressure was 85 systolic and 60 diastolic. The patient recovered.

Summary.—A young woman had an attack of being obsessed by the feeling that she had told falsehoods or made evil statements to her neighbors. To get relief from these she prayed very much. Cleaning and washing of hands exhausted her physically but satisfied a desire for purification. She recovered.

Case 8.—A man aged thirty-six years, married and a barber, complained of nervousness which had been present off and on in attacks since the age of eighteen years. A sister had convulsions. At the age of eighteen years he felt that his genitals became much smaller, and his "sex life died." Following this he had

attacks several weeks to several months in length, in which he had what he called "silly ideas." He would suddenly be seized with the desire to follow a man walking down the street and sometimes would do so. He could not resist touching things on the way to work. Once when contemplating having some photography done, he became obsessed by the idea that a picture of himself would be hard to take. He felt that his body was so light in weight that it might blow away, and he said it felt like chalk at other times. He had a strange feeling that his ideas had their origin in the middle of his back. His better judgment told him that all of these ideas were not true but they annoyed him and even interfered with his work at times. He experienced depression and he had a facial tic. Between such attacks he felt well and able to work. General examinations gave essentially negative results. Hallucinations or delusions were not elicited.

Summary.—A young man had had short recurring attacks since the age of eighteen years in which he was obsessed by certain strange ideas and feelings of unreality.

Case 9.—A man aged twenty-two years, single and a farm laborer, came to The Mayo Clinic complaining of a peculiar nervous condition and head pressure, which had bothered him for several years. He began to stutter at twelve years of age. Three brothers and sisters, his mother and maternal aunt stuttered. At twelve years of age he got such a thrill from looking at a picture of George Washington that he could hardly get his eyes from it for one day. At thirteen years of age a piece of iron fell on his head and caused a fracture of the vertex of the skull. He recovered from this without much ill effect. At fourteen years of age, for about ten days he was obsessed by the idea that he would have to stand with his feet tight together, and picked out certain spots on the floor to stand on, which gave him a feeling of satisfaction. At this age he masturbated a few times but soon read "of its evils" and abandoned it. At seventeen years of age, for about a year, he became obsessed by the desire to start a piece of work on the birthday of some eminent man or some member of his own family and he procrastinated in work until such a day came. Between the ages of eighteen and nineteen he began to be conscious that he was an animal and he then began to hate animals. He knew this was foolish but could not help it. He hated females more than males and did not like to work behind animals. He stated that he thought of animals so much that he could not think of other things and he could not start an important task during a big horse race or live stock show or any event of which he knew animals took a part. At about this time he began to doubt his own existence, his home, his parents, and everything. These doubts he knew to be foolish but they annoyed him and gave him a pressure headache in the region of the site of fracture of the skull. Because of stuttering he secluded himself but remained able to work. He was moderately religious and adhered to a sect that had a strict code of morals. General examination gave negative results. Roentgenograms revealed the site of fracture of the skull.

Summary.—A young man aged twenty-two years, who stuttered at the age of twelve years had begun to have a variety of strange obsessions and compulsions that annoyed him greatly.

Case 10.—A single man aged seventeen years was obsessed by the desire to attend funerals and help care for sick persons. A maternal uncle was queer. His parents had poor control over him. He had always been frail and undernourished

and unlike his younger brother and sister. He progressed in school very slowly and among his playmates was the victim of much ridicule, which he bore poorly. As a child he ran away from home, often remaining away as long as two or three days, but he always returned of his own accord. After he became thirteen years of age, he never failed to attend a funeral in the adjoining country even if he had to walk several miles, and he visited the sick whenever possible. He seemed to be thrilled by a funeral and never showed sorrow which such occasions usually induce.

Summary.—A young man aged seventeen years was obsessed by a satisfaction which he derived from attending funerals and visiting the sick.

Comment on cases 1 *to* 10.—Numerous examples of compulsions, obsessions, and feelings of unreality are to be found in the literature. In Table 1 is presented only part of the phenomena which this series of patients displayed. The effect of compulsions and obsessions on the patient, as well as a lay interpretation of the patient's behavior also are given. In general medical practice, a better understanding of these patients than that expressed by the simple statements of the opinion that is held by society concerning them is rarely attained. The etiology of various consequences of psychopathology is diligently sought for usually without the recognition or the understanding of the underlying psychopathology. When consequences become new causes, and so on almost infinitely, the extreme complexity of such problems of life is apparent. It is obvious how in the occasional person, religion, economic status, personal habits and qualities, social life, disease, crime, and choice of occupation are determined or modified by compulsions and obsessions.

Case 11 is presented in more detail to give the apparent origin and development of such disorders. There are many interesting facts in the life of this patient which are related to his obsession, the presentation of which would make his story too voluminous.

Case 11.—A man of twenty-three years, single, and a junior university student, presented himself because of nervousness which interfered with his ability to study. He was the youngest of a family of seven. One sister had had some difficulty in getting through school, was not considered as capable as other members of the family and suffered from insomnia. A tendency to goiter and to be "high strung" existed among the other members of the family, but they were efficient members of society. The father once suffered a breakdown referred to the stomach, and from which he recovered. The patient was the favorite of the family.

The patient had been a restless child, and before the age of five, in excitement he frequently would jump up and down and bite the side of his hand, until it became calloused. When he was a young boy an inguinal hernia developed which was his excuse for avoiding many obligations which were in any way distasteful to him. At about five years of age, in 1907, he experienced, when standing by an automobile

with engine running at full speed, a certain pleasurable sensation through the whole abdomen which he attributed to the roar of the motor. Thus began an intense interest in automobiles, which manifested itself by cutting all automobile pictures out of magazines. He spent much time in the attic of his home (the children's playhouse) with his automobile pictures, and this haven made play with his brothers and sisters and neighbors' children uninteresting in comparison.

At eight years of age, when in the second grade at school, the patient experienced the same feeling in the abdomen, a kind of thrill, as a result of climbing a tree. He climbed the tree every day and then learned that the "abdominal thrill" was greatest when sliding down the tree just prior to being called to classes by the school bell. It seemed to him that there was a certain spot on the tree where he could experience the thrilling abdominal feeling. Soon after this, probably at the age of nine or ten years, he began definitely to relate these feelings to sexual urges. At eleven years of age he masturbated for the first time spontaneously. Thereafter he began to visualize automobiles vividly (with his eyes closed) when he masturbated to get the "greatest thrill" from the masturbation. His interest in automobiles became intense and he amused and surprised his parents by wanting to go to automobile shows. He did much day dreaming about them. His imagery was especially vivid as to the roar of the engine and he often pictured himself in a car riding with a little girl of his choice. Such dreaming and imagery was so distracting that it seriously interfered with his school work, and teachers, although they liked him, considered him "far away" from his lessons at times. He preferred to remain alone and enjoy such dreams rather than to be with neighbors' children or school children. When in the attic, he said that his mind was a whirl of cars.

At thirteen years of age the patient learned from school children some facts concerning sex which he had difficulty in getting out of his mind for several weeks. At fourteen years of age he masturbated regularly, but visualized not himself but another boy doing this. Then he began to have sexual attraction for this boy and later thought himself to be that boy indulging in sex relations with a girl he liked very well. At this age he began to have a certain amount of fear with any of his sexual desires. He feared that his parents might discover him masturbating. The obsession, previously pleasant, began to be restrained by his judgment and ideas of morals.

At sixteen years of age the patient began to associate with girls much older than himself and enjoy their intellectual chatter and sentimental talk. Ever since that time he had formed attachments for girls which were transitory and easily given up. In the meantime he became disgusted with masturbation and discontinued it, but automobiles continued to stir him deeply, to give him thrills, and to inveigle his imagination to things far from his school work. He had tried hard to be a student, but these distracting influences had made him disappointed and even angry with himself. He had grown restless and tense, and strangely, when he was most restless he considered that he accomplished more work and was in his most efficient state. When he relaxed, he felt grossly incapable, "flat," and there was marked disgust with himself; thoughts turned to possible failure in the future, and on such nights he dreamed of finding himself in company far below the social status to which his ambitions strove.

The patient's financial status made it necessary for him to work part of the time to pay his way through school; he worked in an office. To meet a continuous

stream of visitors was at times very irksome, and he had to be on guard continuously to keep from letting patrons know of his irritability. When he was irritated by the presence of a patron whose appearance displeased him, the vision of genitals, male or female, suddenly would flash before his vivid imagination. This so disgusted him that he had begun to wonder if he were "losing his mind" and in his endeavor to get relief decided to consult a psychiatrist.

The word association reactions were either long in time or gave words indicating unusual association of sex, cars, trees, and events of life, thus crowding out, as it were, the usual normal associations which develop around these words and experiences. He had contemplated the study of a profession but thought he might be more successful in the automobile business. In working out the details of his problem he had learned many things which had formed the basis of reëducation (not of the intellect but of his emotions), and had been able to study more effectually.

In the period of three and a half years since I first examined the patient, he has finished college and professional school.

Comment on case 11.—Educators are learning many of the factors that rob the learning process of its immediate fruits. They rarely include in their calculations any influences such as the patient in case 11 had to combat. He never got good first impressions because of the distractions which have been enumerated. He was aware of the struggle more than of the objective for which he struggled. His memory for work he did in college has been attenuated by influences he had difficulty in escaping. It is difficult for him to apply that knowledge which really never has become a part of him. He is not entirely happy, but is getting along. In the many opportunities that life affords he may yet find a place in which he can feel successful and useful. General examination showed under-nutrition and vasomotor instability. It should be noted that sexual development does not necessarily occupy the importance in some cases that it did in case 11.

The fact that the patient in case 11 was probably different from his brothers and sisters argues against any consistency of heredity. However, the fact that he had been reared in the same environment, and under conditions similar to those of his brothers and sisters, argues also against the consistency of the influence of environment. The problems of this young man show the great need for details of life from birth. Many children have doubtless experienced the roar of an automobile engine without getting a thrill from it, or an obsession over the thrill. In this somewhat unusual child, associations of feelings, objects, and symbols (including imagery) were built up in an extraordinary way. Although these obsessions were pleasurable earlier in

life they finally came to be annoying and humiliating interferences between himself and his goal in life. He could study only by great effort. He learned poorly; he made poor grades. He could not pay attention to the tasks of a college student when a thrill was ever lurking in the background. Restlessness, unusual muscle tension, irritability, and feelings of discouragement were among the by-products. Even his future occupation was menaced as well as suggested by his obsession. There are probably more of such problems among college students than is generally realized, and harsh talk of a dean cannot solve them. Intelligence tests or college entrance examinations will not give much of a clue to such problems.

DISCUSSION

Compulsions and obsessions in their purest forms occur in a syndrome called compulsion—obsession neurosis (a type of psychoneurosis of Freud), or psychasthenia of Janet. Like other symptoms, they rarely occur in pure form. Sometimes they are found with depression of a considerable degree known by some clinicians as psychasthenic depression. They may exist with schizophrenia and states of elation, but are somewhat obscured by these syndromes.

There seem to be two fairly distinct types of the purer compulsive-obsessive disorders. In one, the onset is early and insidious; in the other, the onset is fairly sudden. Prognosis depends on the individual person; but in this series, so far as it has been possible to determine, more of those with sudden onset have adjusted themselves to life than of the group with insidious origin. These patients may have recurrences, as has been demonstrated in some cases. There also seemed to be some correlation between the degree of depression which these patients had and their tendency to recovery. Other things being equal, the more depression with the compulsions and obsessions, the more likely was the patient to make an adjustment. None of this group has been committed to an asylum, although one or two have come near it. One was incarcerated in a penal institution. Nine sought help voluntarily, in sanitariums or hospitals for psychopathic patients.

Under proper treatment (which must be individual) there is prospect of relief and adjustment for many such sufferers. The treatment of choice is management, reëducation and psychotherapy in the hands of a physician experienced in such disorders. General physicians

have been taught how to manage successfully a few of the patients in this series.

Much basic research is needed to learn more of the psychobiologic characteristics and circumstances which eventuate in compulsions and obsessions. To discover these as early as possible and to modify them so that the child may be useful and happy, instead of thwarted, obstructed and eventually made invalid by psychopathologic changes, should be the ideal of those who have the responsibility of child guidance.

SUMMARY

This study is based on experience with thirty-six patients with obsessions, compulsions, and feelings of unreality. The early life and biologic development of most of these patients seem to be somewhat different from the average of society. Sixteen patients were men and twenty were women; the average age was twenty-eight years; seven were teachers; in the immediate families or collaterals of thirty of the thirty-six were varying degrees of instability and inadaptability. In many cases the parents of these patients were of extremely different temperaments.

The somatic complaints of the patients in this series were chiefly centered about the head and abdomen. Associated diseases or lesions in a few were incidental. The metabolism and other physiologic processes of some of the patients were markedly disturbed at times. Histories of eleven cases are briefly presented, showing the development of the phenomena of obsessions, compulsions, and feelings of unreality.

A tabulation of obsessions and compulsions is presented showing the consequences of these to the patient and a lay interpretation of him. Economic, religious, criminal, occupational, social and personal problems in the occasional person are obviously related to compulsions and obsessions.

One case is presented in detail to show the circumstance of the earliest appearance of obsessions in a college student in whom at first they were pleasureable but later interfered with his capacity to study and to attain his goal in life.

Slowly insidious types and types with fairly sudden onset of obsessions and compulsions are apparent in the series.

The prognosis varies in different patients but seems better in those in whom the disorder has been of sudden onset. Other things

being equal, those in whom there is most depression seem to give a better prognosis. Rarely do these patients have to be taken to an asylum, although many are treated in sanitariums.

Treatment is an individual problem and consists in management, reëducation, and psychotherapy in the hands of a physician experienced in neuropsychiatric disorders.

TABLE I

Results of various obsessions and compulsions observed in the series

PATIENTS' REACTIONS		CONSEQUENCES	
Obsessions	Compulsions	From standpoint of patient	From standpoint of society or a lay interpretation
Fear of telling a lie	Frequent confessions to priest	Time consuming; distracting	Peculiar, overscrupulous person
Fear of syphilis	Frequent handwashing	Time consuming (dermatitis of hands)	Fussy, overly cleanly
Dislike for dirt	Cleaning house several times a day	Exhaustion	Very neat, systematic housekeeper
Dislike for dirt	Cleaning house all of time	Exhaustion and vomiting	Serious illness
Dislike fo ɪdirt	Cleaning house all day	Satisfies a desire to be pure	Humble housewife
Dislike for dirt	Sending many clothes to cleaners	Exorbitant cleaning bills	Extravagant
Fear of dying of heart disease	Use of alcohol	Relief	Chronic alcoholism
Fear of catching cold	Extreme precautions of all kinds	Continuous search for protection	Very fussy and inadaptable
Dreadful bodily tension	Breaking dishes and tearing clothes	Relief	"Crazy"
Fear of killing a man	(To kill the man: hypothetic compulsion)	Shame and disgrace (also relief if compulsion is carried out)	Murderer (if compulsion is carried out)
Telling neighbors bad things	Praying	Relief	Overly devout and religious
Desire to start a piece of work only on a great man's birthday	To wait until great man's birthday	Failure to get work done	Procrastination
Character of husband's work (with women)	Cruelty to husband	Extreme remorse at times	Domestic trouble
Fear of getting hungry	To get food	Unable to follow ordinary schedule of work	Poor worker
On getting any distance from home	To stay at home	Economic limitations	Unsociable shut-in
To go to funerals	Going to funerals	Loss of time	Peculiar, tender hearted
Roar of automobiles	Going out of way to see automobiles	Interference with thinking	Poor student
Mother's detached head		Distraction from work and happiness	Peculiar
Dead objects or things associated with them	Avoiding these objects	Great restriction of world in which patient lives and can work	"Superstitious"
Orderliness	To arrange things in rows or straight lines in store	Conflict with reckless careless customers	Irritable grouch
Fear of suffocating	Continually trying breathing mechanism	Unable to work	Short of breath; serious illness
Fear of crowds	Avoiding crowds	Limitations in work	Not sociable
No obsession discovered	Destroying women's garments	Satisfaction of a vague, unexplainable desire	Criminal
Strong sexual urges	Intercourse	Shame and guilt	Very retiring, subdued

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THE POINT OF POPULATION SATURATION ITS TRANSGRESSION IN MAURITIUS

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Desire not a multitude of unprofitable children.
Ecclesiasticus, xvi, 1.

PRELIMINARY CONSIDERATIONS

Thomas Malthus

In his historic *Essay on the Principle of Population as it affects the Future Improvement of Society* published in 1798, Thomas Malthus broke new ground in the examination of the subject of population growth. He set out to prove three propositions:—

(1) Population is necessarily limited by the means of subsistence;

(2) Population invariably increases where the means of subsistence increase, unless prevented by some very powerful and obvious checks;

(3) These checks, and the checks which repress the superior power of population and keep its effects on a level with the means of subsistence, are all resolvable into moral restraint, vice and misery.

That he proved his thesis is borne out by the reputations of many of his supporters, among whom are found many economists of repute, not that they agree with all his ideas, but with the central mathematical law they are all in full accord.

The Law of Population Growth

Prof. Raymond Pearl, having studied the census returns of some twenty countries has cast the law into the following terms:—

Growth occurs in cycles. Within one and the same cycle and in a spatially limited area or universe, growth in the first half of the cycle starts slowly, but its rate per unit of time increases steadily until the midpoint of the cycle is reached. At this point the rate of growth per unit of time is at its maximum.

After the midpoint is passed the rate of growth per unit of time becomes increasingly slower until the end of the cycle. In a spatially limited universe,

the amount of increase which occurs at any particular unit of time at any point of the single cycle of growth, is proportional to two things, viz:

(a) the absolute size already attained at the beginning of the unit interval under consideration, and

(b) the amount still unused or unexploited in the given universe or area of actual and potential resources for the support of growth.

This is termed the Law of Population Growth and it holds good for the multiplication of all things, whether bacteria, vegetation, insects or human beings. The graphical form of the law in which actual population is plotted against time units is a flattened out *S*, and from it, knowing any considerable portion of the curve, the remainder can be filled in.

Factors affecting Population Growth

Before going any further, it is pertinent to notice the factors which influence population growth. Under the terms of the above law, the area is limited, in other words nothing can travel into it and nothing can travel out of it. Being human, man's life is limited by birth and by death, and the birth rate and the death rate are in consequence the dominants. It matters little whether the birth rate and the death rate are both high or whether they are both low; both conditions result in a minimum difference between the two rates. But a high birth rate and a low death rate spell population increase, whereas a low birth rate and a high death rate involve population shrinkage.

In modern times, no country is a completely closed area: it is subject to immigration, which must therefore be allowed for in the curve of population increase.

Alteration of Conditions

When a country changes over from an agricultural to an industrial community, fresh resources are opened up for the population; it is as if the spatially limited area had extended its boundaries, and fresh conditions supervene which modify the original course of the law. The agricultural period closes and with it stops the former rate of increase; the industrial opens and starts a new rate of increase with a greater potential growth. This is merely another way of expressing Malthus's second point as the change over from agricultural to industrial labour renders the means of subsistence of the people affected, greater to a considerable degree.

Present World Conditions

Surveying the various populations of the world, with the exception of China it is found that they are all steadily growing, some more than others, some nearer the summit of the curve than others. China, for which unfortunately there are no reliable statistics available, has long ago reached the top and on an average its population is constant. It would appear to be of importance to find some country which plays a similar rôle but which furnishes accurate data on all aspects of the subject so that economists might state their findings as to the state of population which has reached its maximum growth, from actual fact rather than from deduction.

The Point of Saturation

The highest level of the population curve at which it attains to the horizontal is called "The Point of Saturation."

MAURITIUS PRIOR TO 1920

The Curve of Population Growth

The Colony of Mauritius, situated in the Indian Ocean, furnishes accurate data for a considerable period. Table A gives the census returns at more or less regular intervals from 1767 to 1921 and graph A its graphical representation.

TABLE A

DATE	CENSUS	DATE	CENSUS
1767	18,777	1851	180,823
1777	29,761	1861	310,050
1787	40,439	1871	216,042
1797	59,020	1881	359,874
1807	77,768	1891	370,578
1817	97,847	1901	371,023
1825	88,090	1911	368,791
1846	158,472	1921	376,485

The continuous curve coincides with that demanded by the law of population increase; neglecting the reading for 1871, which is abnormal owing to the malarial epidemic of 1865–67, the census

returns would more readily fit in with the alternate broken-lined curve. Did any new conditions supervene at or about 1850 to increase the population abnormally?

GRAPH A

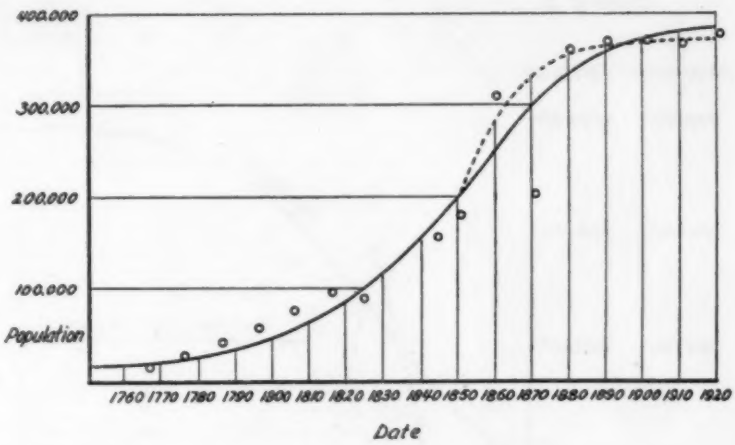


Table B, which is that of the immigration taking place, with its graphical representation graph B, provides the answer.

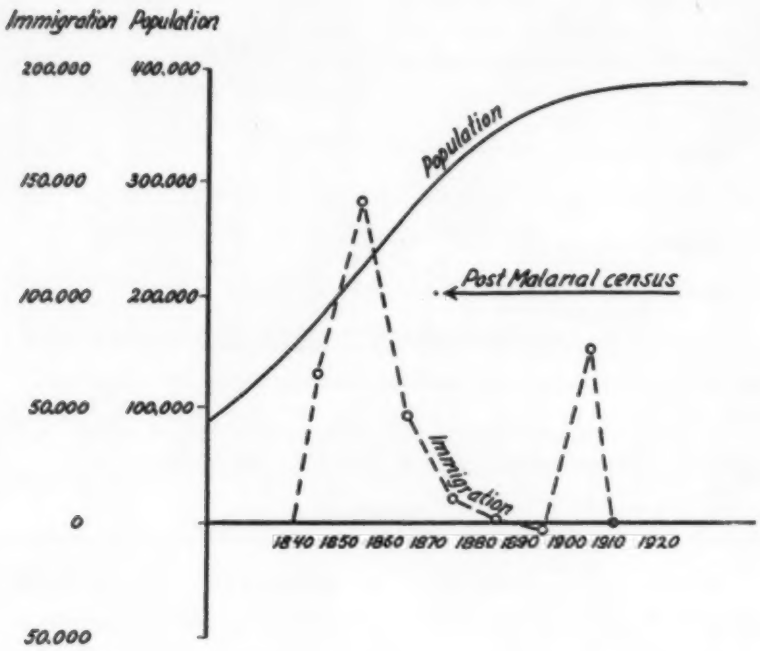
TABLE B

PERIOD	ARRIVALS	DEPARTURES	INCREASE
1841–1850	93,690	27,490	66,200
1851–1860	184,055	42,101	141,954
1861–1870	71,202	23,666	47,536
1871–1880	37,829	25,087	12,742
1881–1890	19,178	17,504	1,674
1891–1900	8,194	10,083	minus 1,889
1901–1910	12,145	4,505	7,640
1911–1920	0	2,298	minus 2,298

There was a large influx of Indian labour which reached its peak in the period 1851–1860; in fact 141,954 of the total 310,050 were, more or less, new arrivals or their offspring. But the modified (Broken-

lined) curve would give a lower population after 1900, consequently for the purposes of this study the unmodified one, which for that period reads at a higher average, will be taken as correct, especially as the broken line neglects the mortality of the malarial epidemic, which is not warranted.

GRAPH B



The point which immediately stands out conspicuously is that by 1920 Mauritius presented the picture of a country which was fast approaching its saturation point of population; for all practical considerations it had already reached it.

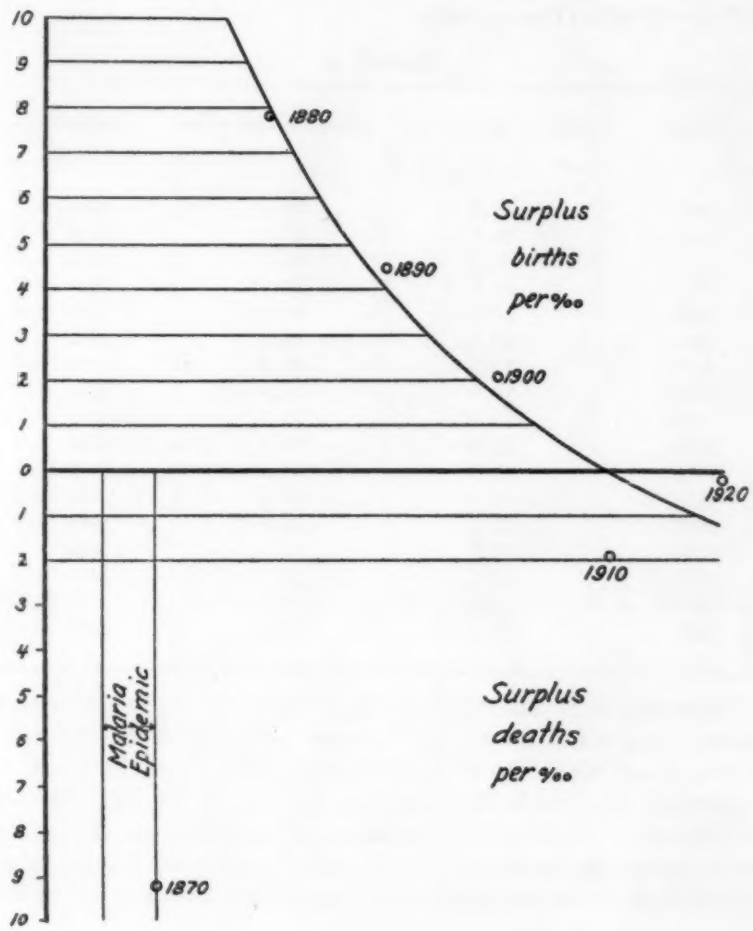
Difference between Birth Rate and Death Rate

In such a case the birth rate and the death rate should agree. In Table C are given the decennial means of the crude birth and death rates and the differences between them. All are expressed in rate per thousand.

TABLE C

PERIOD	MEAN DEATH RATE	MEAN BIRTH RATE	DIFFERENCE
1861–1870	44.1	34.4	minus 9.7
1871–1880	28.5	36.3	plus 7.8
1881–1890	32.6	37.1	plus 4.5
1891–1900	34.5	36.5	plus 2.0
1901–1910	37.2	35.3	minus 1.9
1911–1920	36.8	36.6	minus 0.2

GRAPH C



Unfortunately statistics are not available for the years prior to 1860, especially as the first set of figures of the period ending 1870 are greatly unbalanced by the malarial epidemic. The remaining figures are consistent with the regular curve of Graph C; indeed the influenza epidemic with its high mortality fits into it naturally, a point which is of interest from what will be written further on.

Table C and graph C give additional proof that the population had reached saturation point; it was in fact decreasing as if it had surpassed it and was being brought back by natural causes.

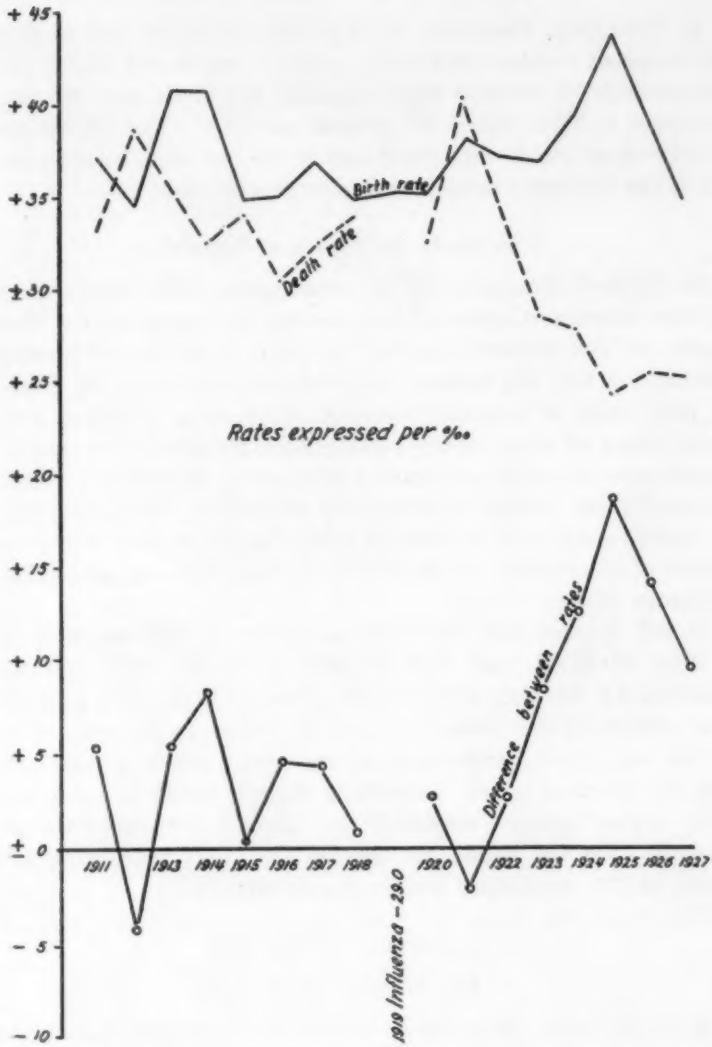
Table D and graph D give the details of the period 1911–1926 under the same headings as those of Table C except that the figures are those of actual annual rates.

TABLE D

YEAR	ANNUAL DEATH RATE	ANNUAL BIRTH RATE	DIFFERENCE
1911	33.0	38.2	plus 5.2
1912	38.7	34.6	minus 4.1
1913	35.5	40.8	plus 5.3
1914	32.5	40.8	plus 8.3
1915	34.3	34.8	plus 0.5
1916	30.4	35.0	plus 4.6
1917	32.5	36.9	plus 4.4
1918	33.9	34.8	plus 0.9
1919	64.9	35.2	minus 29.7
1920	32.5	35.1	plus 2.6
1921	40.3	38.1	minus 2.2
1922	34.5	37.0	plus 2.5
1923	28.5	36.8	plus 8.3
1924	27.7	40.4	plus 12.7
1925	24.1	42.6	plus 18.5
1926	25.3	39.4	plus 14.1
1927	25.1	34.5	plus 9.4

These data show that the increase of the mean death rate over the corresponding mean birth rate between 1911 and 1920 was due to the very large mortality of the influenza epidemic of 1919. If this is neglected, the decade shows a mean increase of the birth rate over the death rate. But considering that pestilence or to put it in modern English epidemic disease, is one of nature's methods of preventing a population at saturation point from going above it, one is not justified

GRAPH D


+ 45
+ 40
+ 35
± 30
+ 25
+ 20
+ 15
+ 10
+ 5
± 0
− 5
− 10
Birth rate
Death rate
Rates expressed per ‰
Difference between rates
1911
1913
1914
1915
1916
1917
1918
1919 Influenza − 29.0
1920
1922
1923
1924
1925
1926
1927

in omitting the 1919 statistics when calculating the average of the period.

The prosperity or otherwise of Mauritius

In 1920 then, Mauritius had a population which had to all intents and purposes reached saturation point. One would expect to find a large amount of sickness approximating the birth rate and the death rate, and a high degree of general poverty. The above statistics already show the former condition to be the case; it remains to be seen if the Colony was suffering from general want.

The wealth per capita of Population

In Table E this question is investigated. The wealth per capita has been taken as a means of comparison, the unit being the Mauritian Rupee, at the moment standing at 13.8 to the pound sterling. In column 4 is the net balance for each year obtained by subtracting the total value of imports from that of exports. Column 5 contains the averages of these yearly balances for periods of five years. The second mean of each ten years is divided by the census, which gives the wealth per person tabulated in column 7. Unfortunately there are merely computed population totals for the middle of the ten year periods of the census, so the wealth has not been calculated for these particular years.

It will be seen that the value per capita in 1921 was ₹ 90.56, that in 1911, ₹ 21.89, and that in 1901, ₹ 16.54. The first figure is explained by the very large export values of 1919, 1920, and 1921 due to an artificial sugar boom immediately following the war. Considering the war years, the balance on the credit side is normal compared with the previous years, if anything slightly on the low side when the yearly index figures (weighted) are allowed for; these are given in Table F. On the whole for the twenty years preceeding 1920 the wealth of the population had increased slightly.

MAURITIUS AFTER 1920

The lowered Death Rate

With the inflow of ready money in the immediate post-war years, there came a great spending; one of the items of official expenditure was the price of the effective consideration of the medical and sanitary problems of the island with a resultant spectacular drop in the death rate from 40.3 0/00 in 1921 to 24.1 0/00 in 1925; a coincident increase

in the birth rate occurred from 38.10/00 to 42.6 0/00, whether post-epidemic or post-boom it is needless to consider here. This meant that in 1925 there was a surplus of 18.5 0/00 births over deaths.

TABLE E

DATE	IMPORTS ₹ 1000	EXPORTS ₹ 1000	NET BALANCE ₹ 1000	MEAN 5 YRS. BALANCE	POPULATION	WEALTH PER CAPITA
1897	27,056	36,654	+ 9,598	.....	.....	.....
1898	28,326	31,886	+ 3,560	.....	.....	.....
1899	28,181	27,381	− 1,800	.....	.....	.....
1900	23,053	31,575	+ 8,522	.....	.....	.....
1901	20,400	28,993	+ 8,493	+ 6,146	371,023	₹ 16.54 Cr.
1902	21,918	36,204	+14,286	.....	.....	.....
1903	26,611	35,671	+ 9,060	.....	.....	.....
1904	24,175	42,006	+17,831	.....	.....	.....
1905	18,677	37,728	+19,051	.....	.....	.....
1906	20,401	37,156	+16,755	+15,397	.....	.....
1907	21,799	40,479	+18,680	.....	.....	.....
1908	17,211	33,464	+15,253	.....	.....	.....
1909	28,937	32,393	+ 3,456	.....	.....	.....
1910	37,258	37,155	− 103	.....	.....	.....
1911	37,762	40,803	+ 3,077	+ 8,073	368,791	₹ 21.89 Cr.
1912	32,267	37,184	+ 4,917	.....	.....	.....
1913	37,004	33,616	− 3,388	.....	.....	.....
1914	37,960	59,966	+22,006	.....	.....	.....
1915	48,064	56,220	+ 8,156	.....	.....	.....
1916	53,967	74,310	+20,343	+10,407	.....	.....
1917	42,199	61,926	+19,727	.....	.....	.....
1918	42,921	55,732	+12,811	.....	.....	.....
1919	47,037	127,862	+80,825	.....	.....	.....
1920	96,186	127,507	+31,321	.....	.....	.....
1921	127,116	157,900	+30,784	+35,094	376,485	₹ 90.56 Cr.
1922	77,380	102,387	+25,007	.....	.....	.....
1923	80,036	79,295	− 741	.....	.....	.....
1924	80,930	52,460	−28,470	.....	.....	.....
1925	61,932	44,664	−17,268	.....	.....	.....
1926	50,734	47,153	− 3,581	−5,011	391,600	₹ 13.05 Db
1927	55,186	56,613	+ 1,427	.....	.....	.....

TABLE F

DATE	WEIGHTED INDEX	DATE	WEIGHTED INDEX
1914	100.0	1920	243.6
1915	121.8	1921	220.3
1916	141.8	1922	205.2
1917	169.7	1923	179.4
1918	203.7	1924	189.1
1919	235.5	1925	175.6
		1926	166.1

The actual figures for the years following 1920 are given in table D and graph D.

The Population Growth

This surplus of births naturally affected the total population as is shown by Table G. The population of a particular year is computed by considering the surplus births per thousand in combination with the population of the previous year building up the whole on the census of 1921. Graph G shows this increase to be a concave curve

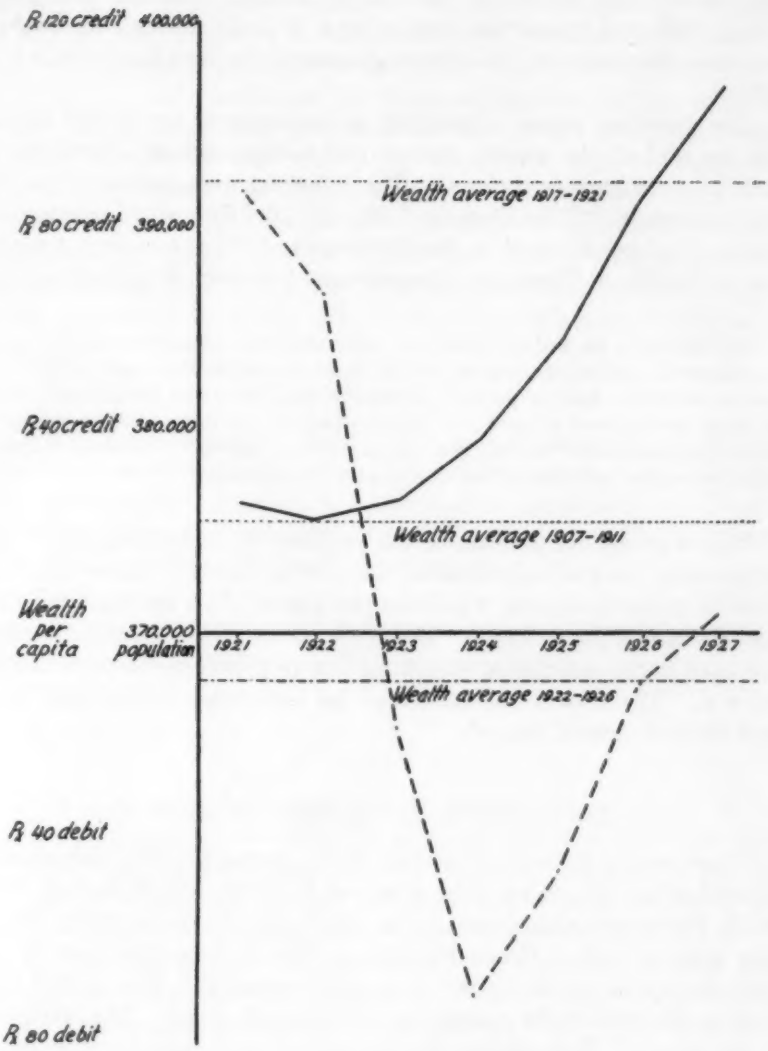
TABLE G

DATE	POPULATION	NET TRADE BALANCE	WEALTH PER CAPITA
1921	376,485	plus R 30,784,000	R 87.50 Cr.
1922	375,600	plus 25,007,000	66.75 Cr.
1923	376,600	minus 741,000	1.92 Db.
1924	379,700	minus 28,470,000	75.00 Db.
1925	384,500	minus 17,268,000	45.75 Db.
1926	391,600	minus 3,581,000	9.17 Db.
1927	397,100	plus 1,428,000	3.59 Cr.

N.B. Cr.....credit, Db.....debit.

A concave population curve indicates the beginning of a cycle in population growth. It has already been pointed out that a second concavity can arise when the means of subsistence increase. But have the latter increased ? Table G and the broken line in graph G show the wealth per capita during this period.

GRAPH 6


R 120 credit 400.000
R 80 credit 390.000
R 40 credit 380.000
Wealth per capita
370.000 population
R 40 debit
R 80 debit
Wealth average 1917-1921
Wealth average 1907-1911
Wealth average 1922-1926
1921
1922
1923
1924
1925
1926
1927

The wealth per capita of Population

The fat years of 1919 to 1922 have been followed by lean such as have never been known in the Colony before. For the five years ending 1926 each inhabitant was in debt ₹ 13.05, though the broken line shows the deficit to be adjusting towards the zero line in 1926 and 1927.

Are there any means of putting up the value of the export trade? Can the soil of the purely agricultural community of Mauritius be made to yield greater returns? The following is an extract from the local newspaper "'The Cerneen" of July 12, 1928, which contains a résumé of a speech made to the Tobacco and Fibre Growers Association by Dr. H. A. Tempany, Government Director of Agriculture:–

> But the search for suitable subsidiary industries was no easy matter; it had to be recognised that as matters stood this maintenance of the sugar industry at least at its present total of production was essential, otherwise the industry could not carry its overhead charges . . . In all efforts to develop subsidiary industries it must be remembered that the great majority of the cultivable lands were already under cultivation and this further complicated the question.

This way lies no solution of the problem of overpopulation. The means of the people's subsistence have not increased. The continuous curve of graph G can but represent one aspect of an average the other side of which is yet to come. This does not mean bringing the population back to the zero line of saturation but to a corresponding minimum below it. The task set by nature to the population is to shrink by at least sixty thousand persons.

The Probability of Population Shrinkage

There seems little hope of this being brought about voluntarily. Mauritius has still to take the words of Jesus the son of Zadeck, with which this study commences, as as applicable to its everyday life as they were to that of Greek Palestine. The average birth rate of the past sixty years is 35.5 0/00; it is most improbable that it will ever drop below 30.0 0/00 except as an isolated event. The vigilance of an efficient Medical and Sanitary Service is keeping the death rate consistently low at about 25 0/00, which leaves a probable surplus of births of 10 0/00 and a very improbable one of 5 0/00. There is therefore no hope from this quarter.

The third point of Malthus's Thesis

Professor Michael Guyer in his text book on Heredity entitled *Being Well Born* remarks trenchantly "If man is not intelligent enough to take his own evolution in hand and keep it within the limits of its own food supply, then nature will do it for him in the same old crude ruthless way; war, famine and pestilence will become the final arbiters."

As far as Mauritius is concerned war is out of the question. Famine can conceivably become a possibility; already there is a general lack of proper nourishment among the masses and their living conditions are of the lowest. It is precisely in such circumstances that epidemic disease obtains its footing. The Malarial Epidemic, the remembrance of which is still a bye-word, took six years to kill 62,596 persons and the influenza Epidemic in 1919 only 11,063 in one year.

SUMMARY

It has been shown that Mauritius, a country possessed of accurate statistics, has reached the point of population saturation. This has been accompanied by the evil consequences prophesied by Thomas Malthus. By a series of unusual events it also provides the picture of a country which has actively transgressed this saturation point. To the scientific world in general the next few years of the life of Mauritius, spent in returning to this average, will be of great interest; to Mauritius in particular they will be of vital import.

* * *

ANNEXURE

It is impossible to obtain precise statistics in support of Dr. Tempany's statement, as there are no figures published in connection with the total capital invested in the sugar industry of Mauritius from which would be deduced the rise or fall of sugar produced per rupee invested. Mr. Phillip Galea, the Secretary of the Chamber of Agriculture, has stated to me as a fact that the costs of production in recent years have gone up to a greater degree than have the returns. Fifteen years ago twenty to twenty-five million rupees per year were required to finance a crop; the corresponding sum is now forty million, a rise of 160%. This however agrees with the latest obtainable index, that of 1926, which is 166.1 compared to the standard 100 of 1914 (Table F).

TABLE H

DATE	ACREAGE UNDER CANE	SUGAR CROP 1000 KILOS	CROP VALUE MILLION RUPEES	POPULATION	PERSONS PER SUGAR ACRE	SUGAR PRODUCED PER ACRE RUPEES
1907	.....	164.1	25.11	.....	.....	.....
1908	.....	195.9	29.78	.....	.....	.....
1909	133238	252.0	42.49	.....	.....	339
1910	150501	222.8	31.59	.....	.....	211
1911	150692	169.6	32.83	368791	((2.55))	218
1912	154255	213.1	30.69	.....	.....	198
1913	160012	249.7	34.71	.....	.....	217
1914	166016	277.4	62.86	.....	.....	390
1915	170435	214.5	50.54	.....	.....	298
1916	174765	209.1	51.94	(372638)	((2.25))	297
1917	175606	226.0	51.21	.....	.....	328
1918	175923	252.4	61.59	.....	.....	344
1919	179094	235.2	104.33	.....	.....	582
1920	179240	259.9	257.98	.....	.....	1345
1921	179780	197.2	47.43	376485	((2.12))	264
1922	173519	231.1	64.15	.....	.....	371
1923	171227	201.6	76.83	.....	.....	448
1924	167165	224.7	58.47	.....	.....	373
1925	163407	241.2	45.05	.....	.....	277
1926	162102	192.6	41.60	(391600)	((2.27))	257

Estimated population in brackets.
Five years average in double brackets.

From comparison of Table H with Table F it is obvious that the value of the sugar crop has not kept pace with the index figure. Table H shows the acreage under sugar cultivation since 1909. From personal conversation with the manager of a company having very large sugar interests in the Island I learn that the drop in acreage is due to the fact that it no longer pays to plant this land. The number of persons a sugar acre must support remains more or less constant over the last twenty years as would be expected at the point of population saturation.

There is a possibility of increasing the value of the yield of the ground by growing secondary crops during the three or four months between the reaping and the replanting of the cane. At present this is at the stage of a suggestion which if adopted will take time to

put into practice; what Mauritius requires is immediate increase in wealth rather than its problematical promise in a few year's time.

In this study the mathematical aspect of the logistic curve has been intentionally avoided. It is fully dealt with by G. U. Yule in his presidential address of 1924/5 before the Royal Statistical Society. (Proceedings of the Royal Statistical Society, Vol. LXXXVIII, Part I., Jan., 1925.)

For my authorities, from lack of access, I have been limited to the above address, to "Mankind at the Crossroads" by E. M. East (Scribner; London, 1926) and to "Being Well-born" by M. Guyer (Constable; London, 1928) all of which give references to the bibliography of population growth. For the statistics quoted I have drawn on "The Epidemics of Mauritius" by D. E. Anderson (Lewis; London, 1918), the reports of the Customs and the Registrar General's Departments, and on the Census Returns of 1921, all of the Colony; also on the Mauritius Almanack and on Colonial Office Year Books.

NOTE

In using the first method of fitting the logistic curve as given by Yule in the paper referred to above, when the census returns for 1861, 1891, and 1921 are taken, the limiting population is 378,200 and the year of the point of inflection 1843. I am grateful to Mr. R. A. Watson, B.A., Director of the Royal Alfred Observatory of Mauritius for checking this result. (The curves of Graphs A and B are free-hand.)

ECOLOGY OF AMERICAN NOTABLES

BY STEPHEN S. VISHER

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The evidence now available indicates clearly that the birthplaces of Americans who attain national prominence for constructive achievement and are widely recognized as leaders are very unequally distributed, certain areas having many, in proportion to population, and others few[1]. The geographical facts of distribution being available, an ecological study may well consider the probable effects of the environmental influences in producing the types of people here considered.

Let us begin by summarizing the geographic distribution, as shown by the following groups of diverse and impartially selected types of prominent persons: the members of the National Academy of Sciences; American Academy of Arts and Letters; National Academy of Design; National Institute of Arts and Letters; scientists starred in *American Men of Science;* persons sketched in *Who's Who in America,* with women considered separately; presidents of 102 largest educational institutions; deans of leading schools of law and education; presidents of American Society of Civil Engineers; millionaires; farm leaders sketched in *Rus;* labor leaders sketched in *Who's Who in Labor.* Putting all these groups together, we find that when the States are classified according to the groupings given in the Census, the relative productivity of the various groups of states has been as follows: New England, 8; Middle Atlantic, 4; South Atlantic, 1.5; South Central, 1; East North Central, 4; West North Central, 3.7; Mountain, 2.5; Pacific, 3.

On the whole, the most noteworthy fact shown by these figures and also those of the individual States is a south-ward decline in the

[1] Visher, S. S. Geography of American Notables. Indiana University Studies, No. 79, 1928, pp. 140. *American Journal of Sociology,* 1925, 1929. *Scientific Monthly,* 1922. *School and Society,* 1924, 1925. *Proceedings of Indiana Academy of Science,* 1920, 1924, 1927, 1928.

number of prominent persons in proportion to the population. This southward decline, however, does not prevail everywhere even in the well-settled parts of North America, for from Massachusetts northward into Quebec there is a decline, and also northward from southern Michigan, Wisconsin and Minnesota. Furthermore, this strong tendency for a southward decline often does not prevail within a State.

A second important phase of the matter is found in the fact that in proportion to population, cities have yielded far more notables than have the country districts; towns have done even better (except for the most eminent leaders), and choice residential districts and suburbs of cities best of all.

Still a third noteworthy feature of the distribution of the birthplaces of American leaders is the fact that areas which are relatively favored geographically in respect to climate, topography, soil or accessibility commonly yielded more notables in proportion to population than did nearby areas which are less favored. The yield, however, is by no means proportional to geographic wealth, or advantages, and there are important exceptions.

With these generalizations as to the relation of the distribution of notables in respect to climate, cities and other geographic conditions in mind, we may proceed to study each of them in greater detail.

CLIMATE

The theory that a fairly favorable climate is a prerequisite to a high civilization, and hence to the yield of numerous leaders, is not adequately tested by the data here studied, since all parts of the United States which were well-populated at the birth of the notables here studied have at least a fairly favorable climate. Nevertheless both the southward and the far less marked northward declines are completely in accord with that hypothesis. This does not mean, however, that differences in civilization or achievement can be explained by climatic differences alone. On the contrary nearby areas with essentially the same climate differ greatly in civilization, as measured by the yield of leaders. There are only slight differences in the climate of southeastern and southwestern Indiana, but the former produced many leaders and the latter few. The climate, (and also the topography and soil), of the southern fourth of Michigan closely resemble those of northern Indiana, but southern Michigan has produced many more notables. In Ohio, the climate of the southern and southeastern

parts, which have yielded few notables, is not appreciably different from that of the adjacent regions to the north and west, which have yielded many leaders. The same is true of the Blue Grass region of Kentucky and the adjacent areas, which have yielded few notables. On the other hand, the climate of the northern parts of Michigan and Wisconsin is sufficiently different from that of southern Michigan and Wisconsin to make important differences in the agricultural attractiveness of these sections. The northern sections are too cold for the growing of much corn or even wheat, and the prolonged and snowy winters are objectionable in various respects. Likewise, the climate of southern Illinois is probably somewhat less desirable than that of northern Illinois, but the difference is by no means sufficient to explain the great difference in the yield of leaders, as is shown by the fact that northern Indiana, with a climate closely similar to that of northern Illinois, is less productive of leaders than is southern Indiana, where the climate closely approaches that of southern Illinois. Hence we conclude that while the direct effects of climate have much to do with the general distribution, there are other important factors which often overcome its effects.

One of these other factors is an indirect effect of climate, for the weather imposes conditions which effect the composition of the population. For example, the long, hot summers of the South are favorable to negroes and have led to a large negro population. Conversely, the long, cold winters of Minnesota are unfavorable to negroes and are not at all to the liking of the easy-going type of whites. Hence Minnesota has few of these unproductive types. Thus, although Missouri contains many superior white people, and has yielded many leaders, its contribution to leadership, in proportion to population, is much smaller than that of Minnesota. This southward increase in the percentage of easy-going people, made possible by milder winters, is presumably one of the chief reasons for the southward decline in the yield of notables.

Climate influences the number of notables also by affecting the energy of the people. Two groups of equal ability, wealth, opportunity and ideals will differ in the number of eminent people produced if the groups are situated in climates which differ significantly in quality. In the more enervating climate more will-power (effort) is required to accomplish undertakings which merit wide recognition.[2]

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[2] Huntington, Ellsworth. Civilization and Climate. New Haven, 1915, 1924.

TOTAL WEALTH

There is abundant evidence that many relatively rich areas have produced more leaders in proportion to population than have certain poorer ones. In each of the six central states of Ohio, Illinois, Indiana, Michigan, Wisconsin, and Kentucky studied in detail, the areas relatively productive of notables have conspicuous geographic advantages over other areas which are less productive. Examples include the Kentucky Blue Grass region and the relatively productive northern parts of Illinois and Ohio and southern parts of Michigan and Wisconsin. The relationship is often so apparent that Frederick J. Turner, the eminent historian, has said, "It often seems to be largely a matter of topography; the level lands yield leaders as well as crops, while the rugged lands produce few of either."

On the other hand, in Indiana and in many other states, the areas of greatest wealth, as the term is ordinarily used, have not been nearly so productive as some poorer areas. Such exceptions encourage further investigations of the inviting theory that "as wealth increases so does productivity of leaders." Satisfactory estimates of the comparative wealth of different geographic areas are not available, partly because there are so many aspects of wealth, some of which conflict, for example, "grand scenery" and agricultural productivity. Furthermore, mineral wealth has no real value until mined, and even then is often not beneficial to the community which produces it. Other types of wealth, owned by outsiders, do relatively little service to the people of the area containing the wealth. Nevertheless, the Census Bureau's estimate of the wealth of states in 1904 (the estimate nearest the birth of the notables studied) gives some interesting light on our problems. Dividing the totals for each state by the area of the state, we obtain the average wealth per square mile. The resulting map resembles in a general way the maps showing the productivity of the states in notables.[3] The exceptions, however, are clearly sufficient to prove that wealth per square mile is not a predominate factor. For example, the Rocky Mountain States have least wealth per square mile, only about one-third as much as the South Central States, but the Rocky Mountain States yielded more than twice as many notables as the South Central States in proportion to population. When

[3] Visher: Fig. 11, Geography of American Notables, *loc. cit.;* Variations among the states in wealth. *Journal of Geog.*, vol. 24, pp. 26–30, 1925.

individual states are considered, more striking discrepancies are disclosed. Louisiana, for example, had nearly twice the wealth in 1904 per square mile but only $\frac{1}{30}$ the productivity of Maine. Similarly, Rhode Island had in proportion to area over twice the wealth of Connecticut but less than half the productivity in proportion to population. Numerous other exceptions occur. If instead of the wealth per area, the wealth per capita is considered, there is even less correlation with productivity.

MINERAL WEALTH

New England, which has yielded most leaders, has least mineral wealth, as ordinarily defined. The South Central States, which have produced fewest notables, are surpassed in total mineral wealth by not more than two other groups of states, if indeed by any. When detailed studies are made of parts of each of the central states where important amounts of mineral wealth are found, they throw some light on the significance of minerals so far as yield of leaders is concerned. The sections of Indiana, Illinois and Kentucky which have most mineral wealth have yielded almost no notables, and those of Ohio, few. In Wisconsin, likewise, the southwestern counties which were settled chiefly in the 1840's and 1850's chiefly because of their lead deposits, and which supplied much lead and zinc in the 60's and 70's have yielded very few notables, although other parts of southern Wisconsin have yielded many. In Michigan, on the other hand, the salt-producing area near Saginaw Bay has done fairly well in yielding notables, but salt extraction engaged only a minute fraction of the population.

TOPOGRAPHY

Professor Turner's generalization as to the correlation between level land and yield of notables deserves further consideration. Within each of the central states studied in detail, there are considerable variations of topography. In Ohio the areas which have yielded fewest notables, relative to population, are almost the most rugged, but another area (the Black Swamp) which has yielded few is flat. In Indiana, the most rugged area has yielded few notables, but much smooth land has done no better, and one of the counties (Switzerland) which has yielded most notables in proportion to population is one

of the most rugged. In Illinois a large share of the relatively sterile southern section, containing half of the state's population of 1870, is smoother than much of northern Illinois, the birthplace of many notables. In Wisconsin, the relatively hilly unglaciated section has yielded few notables, but smooth areas elsewhere are equally sterile, while other hilly areas are productive. In Michigan, likewise, there is no clear relation between yield and average topography. In Kentucky, the most level part of the state, at the west, yielded almost no notables. The Blue Grass region is, however, less rough than most of the state, and has excelled in leaders.

Among the groups of states, likewise, there is no clear correlation between yield of notables and topography. New England has a smaller percentage of fairly smooth land than all but one or two other groups of states, and the groups with largest percentage suitable for tillage include two which stood relatively low in the yield of leaders.

SOIL

The groups of states with the most fertile average soil are the West North Central and West South Central, followed probably by the East North Central and the Western States. The groups with the poorest average soil are the South Atlantic, New England and East South Central. It is therefore apparent that there is no close correlation between the yield of notables by large regions and the average soil conditions therein. Among the individual states some correlation is seen, but it is not close. For example, Iowa has far richer soil, on the average, than Michigan, but Michigan has excelled in yield of notables. Within the states, in general, the areas of poorer soil yield fewer notables than nearby areas of better soil, but among the five states studied in detail, and within each of them, there are marked exceptions. Michigan's soil probably averages the least productive of these five states, as Michigan is as cool as any, is more humid, and has much sandy land, but Michigan stands almost at the top in the yield of notables. The famous Blue Grass Region of Kentucky with its fertile soil has yielded most of Kentucky's notables, but the Jackson Purchase, in the Mississippi Delta at the west, with good soil has yielded no starred scientist and almost no other notables. Likewise, the soil of the Wabash Lowland of southwestern Indiana is decidedly more fertile, on the average, than the soil of southeastern Indiana, but the latter region far excelled in yielding notables.

DISEASE

Regional contrasts in disease help explain the relatively low rank of the South, as malaria and the hookworm have been, in recent decades, relatively more prevalent than further north.

RACE

As few negroes or Mexicans have won national recognition, the southward decline in the yield of notables in proportion to population is partly due to the increase southward of negroes, in the eastern and central states, and of Mexicans in the western states. Oklahoma's relatively low rank is also partly accounted for by the fact that a large share of the population was Indian before 1880.

STAGE OF SETTLEMENT

It has often been asserted that frontiers can not be expected to produce leaders, as the people are engaged in "hewing homes out of the wilderness." Some evidence in favor of the hypothesis is the fact that the southern halves of the population in Michigan and Wisconsin have yielded many more notables than the northern, which had not by 1860 developed beyond the cruder stages of frontier conditions. Likewise, there was an increased yield of starred scientists in proportion to population from 1860 to 1870 or 1880 in the midwest. This increase suggests, but does not prove, that stage of settlement is important. That it is not a dominant influence, has been demonstrated by Turner by his astonishing array of leaders who were born in the early decades of considerable settlement in the midwest.[4] The declining yield in proportion to population which has occurred in the Eastern States, and recently in some of the North Central States also suggests that the yield of leaders does not necessarily increase as settlement becomes closer and contacts more frequent, and civilization greater.

Among the groups of states, New England was the first to be well peopled and to pass beyond the agricultural stage, but in these regards it was only a little ahead of Pennsylvania, which has yielded only one third as many notables, relatively. Likewise, Quebec, the first Canadian province to become populous, ranks lowest, it appears, in the yield of notables in proportion to population. Furthermore, Vermont,

[4] Turner, Frederick J. The Children of Pioneers. *Yale Review*, July, 1926.

which was predominantly rural when most of the notables were born, far excelled Rhode Island, which was largely urban.

DENSITY OF POPULATION

The present study reveals no clear evidence that yield of notables correlates closely with density of population, if urbanization be excluded. Davies, in his study of the American states, found almost no correlation when the entire state population was used.[5] There is, to be sure, frequent correlation between the percentage of native whites of native parentage which is urban, and the yield of notables, especially of the more highly selected type. So many exceptions occur, however, that the hypothesis that yield of leaders increases with density of population as such (urbanization excluded) can not be said to receive much support from American conditions, although in France it has considerable support.[6]

ACCESSIBILITY TO COMMERCE AND EDUCATION

The relatively large number of notables born in cities and towns, compared with the yield from the country districts, and the especially large percentage from the best towns of each county, the county seats, especially if they have colleges, suggests that remoteness is unconducive to the production of leaders. However, the capitals and chief cities of the southern states have yielded fewer notables in proportion to their white population than have some rather remote New England valleys, or Wisconsin "clearings." Within Indiana, the counties nearest Chicago yielded far fewer notables than did those of north eastern Indiana, near no important center.

The environmental factors discussed in the preceding pages have each been seen clearly to be inadequate individually to account for contrasts in the yield of notables. Perhaps a combination of a number of them will suffice.

OPPORTUNITIES FOR INDIVIDUAL ADVANCEMENT

Of course, climate, topography, soil, resources, accessibility, etc., affect the comparative opportunities for individual welfare and thus

[5] Davies, G. R. A Statistical Study of the Influences of the Environment. *Quarterly Journal, Univ. of North Dakota*, April, 1924.

[6] Odin, Alfred, summarized at length by Lester F. Ward, *Applied Sociology*. New York, 1906.

greatly affect the character of the population, but their influence is chiefly selective rather than direct. Much evidence indicates that the parents of notables are alert and highly mobile. Such people are anxious to better their conditions and possess the requisite boldness, energy, and resources to move relatively readily. In fact one of the outstanding features of the present investigation is the evidence that leaders are chiefly descended from superior types of people and that such people tend to concentrate in favorable localities. Available facts as to the occupations of fathers of notables (summarized elsewhere) can be best explained on the theory that the mentally able, serious-minded people tend to concentrate in occupations where they can use their special qualities to best advantage, while the less intellectual and the easy-going types are largely represented in occupations which require less mental alertness and activity.

The facts as to the distribution of birthplaces as to size and character of place also lend strong support to this hypothesis.[7] The mentally alert, ambitious types quite logically gather in centers of population and in centers of political and educational activity (the county seats, the college towns). In the Middle West, where in 1860, nine-tenths of the population was rural, because of the abundance of cheap good land and the newness of the settlements, the towns were nearly all small, but they already contained, it appears, a considerable share of the parents of the leaders. As opportunities for gaining a livelihood in the towns increased, a larger and larger fraction of the alert, ambitious people moved to town, and more and more of them gathered in the chief towns of their region, the county seats or the cities. But the cities also attracted many manual laborers in the trades and factories so that, in proportion to population, the superior type commonly forms a smaller percentage, except in certain residential sections and suburbs, than in the smaller county seats with their fewer manual laborers. Nevertheless, in the production of the most outstanding scientists, artists, architects, authors, etc., the large cities lead in proportion to population, despite their large element of average people.

It appears probable, therefore, that the chief factor affecting the yield of notables is the quality of the population, which depends in part on the relative geographic attractiveness of areas, in part on whether the region is already occupied by non-progressive peoples,

[7] Huntington, Ellsworth. The Character of Races, New York, 1925; Builders of America, New York, 1927; Visher, S. S. Geography of American Notables, *loc. cit.*

or by enough of them to make the locality unattractive to the other type or to submerge it, and in part upon conditions elsewhere, perhaps far away. For example, the revolution of 1848 in Germany led to the migration to America of thousands of the most progressive, idealistic, German people. Where they settled depended in part upon routes of transportation readily available such as the Erie Canal, Great Lakes, and early railroads, in part on the areas then open to free settlement or where land was cheap, and in part upon the activities of immigration agents, or enthusiastic writers, etc. Localities in which such superior Germans settled in large numbers yield relatively many leaders. (About one-fifth of the starred scientists born in Wisconsin have German names, about one-sixth of those born in Ohio and one-eighth of those born in Indiana.) Far more important numerically than the Germans in yielding American leaders were the Yankees, Quakers, and Scotch-Irish. The last two groups largely spread into the Southern Piedmont during the 18th and 19th centuries, but during the 19th century sent many representatives from thence to the midwestern states. Because of the complexity of their movements, however, they are less easy to trace statistically than are the Yankees, most of whom went rather straight westward, either in one migration from New England to the Middle West or with a pause of a generation or more in New York. Evidence as to the spread of New Englanders has, moreover, been well summarized.[8] Evidence of their large representation in the blood of American leaders is given by Cattell, based on a questionnaire answered by scientists,[9] and by much other evidence. For example, the relative yield of each of the central states correlates closely with the percentage of the population of New England ancestry. Likewise, the sections of Indiana and its neighboring states which in 1870 contained relatively many New Englanders yielded relatively many notables.

SUMMARY

After a summary of the contrasts in the yield, in proportion to population, of American notables of numerous sorts, various environ-

[8] Mathew, L. K. The Expansion of New England, Boston, 1909; Barrows, H. H. Geography of the Middle Illinois Valley, State Geol. Survey, Bulletin 15, 1910.

[9] Cattell, J. McKeen. American Men of Science, 3d edition, New York, 1921, p. 782.

mental conditions suspected of being significant were considered. Differences in climate affect the composition of the population, especially its activity, and hence help explain some of the broader aspects of the yield of notables, but climatic contrasts alone can not explain the local contrasts. Areal wealth correlates with yield poorly, when large regions are compared, but within small areas, the more wealthy localities usually yield more notables than nearby less wealthy. Exploited mineral wealth appears unconducive to notables. Topography alone correlates only slightly with yield of notables. Fertile soil appears more favorable for notables than nearby less fertile soil, but between more remote areas there is almost no correlation. Disease and race both help explain the southward decline in yield of notables among the States, but little else. Stage of settlement clearly plays only a small part, after the cruder frontier stages are past. Density of population as distinct from urbanization does not correlate closely with yield of American notables. Accessibility to commerce and education is of some significance.

Of much more importance than any one or two of the foregoing is a favorable combination of several. Areas in which superior people can make a livelihood congenially, obviously attract such people and hence often yield relatively many notables. Conspicious among such localities in America are the best towns of an area, the county seats, especially if they contain colleges, and the cities. Among the larger regions, the yield of notables in proportion to population varies with the percentage which is mentally alert, ambitious, and persistent, which in turn, varies with geographic and social conditions, both within the area and in the regions from which the people came. In other words, notables can be only partly explained by the environmental conditions of the locality in which they were reared. Much depends on the conditions affecting their ancestors.

NOTES

PERCEPTION AND LANGUAGE

[*Read at the International Congress of Psychology. Yale University, Sept.* 1929]

It is to be assumed as a methodological postulate that there is a general correlation between the range of perceptual content of an organism and its behavior-system. This does not mean, of course, that for every possible item of perceptual content there is a corresponding item of response. There is no one-to-one correspondence of element to element. Indeed we cannot think either of perceptual content or of behavior as analyzable into discrete elements. The correlation that is to be postulated is a correspondence of patterning—a correlation of organized functional systems. Any distinction which an animal is able to perceive in its surroundings will, under appropriate conditions, discriminate in its behavior. And any distinction which remains undiscriminated in its behavior we must assume not to characterize its perceptual field. This postulate has usually been applied with reference to sensory discrimination: to determine, for example, the color vision of fish, or the auditory sensitivity of the frog. But the postulate has a much wider applicability than this: namely, to the organization of perceptual content. The type and degree of organization that we can observe in the behavior of an animal is evidence of a corresponding type and degree of organization of its perceptual field.

Speech is a unique form of behavior peculiar to man. It is highly organized. Man does not speak except as he speaks a language, and language has a characteristic and complex structure. Moreover, in speaking man is not indulging in a set of vocal gymnastics. Speech is, as it were, geared to mesh with all other human activities. The language that a man speaks applies to the things and events that he experiences, and its systematic organization reflects the organization of what he sees and hears and feels.

It has sometimes been said that an animal psychologist is forced to use indirect methods of investigation because the animal is unfortu-

nately unable to speak and tell him what it experiences. This betrays a curious misapprehension. As if the animal's inability to speak were not itself a positive and significant witness of what it experiences! No one would deny that speech is evidence of conceptual thought. If an animal cannot express its thoughts in language, that is because it has no thoughts to express; for thoughts which are not formulated are something less than thoughts. But it is equally true that if an animal is unable to describe what it sees and hears, that is because what it perceives is essentially inexpressible in the terms of language. If *per impossible* a psychologist were endowed with a magic gift which enabled him to look with a dog's eyes and hear with a dog's ears, he no more than the dog could describe in words what he thus perceived, for the words of human speech apply to a world of things and qualities, acts and relations, which do not exist for the dog either in their distinctiveness or in their interconnections. The patterning of the animal's world is at once vaguer in its outlines and simpler in its design.

We have long been accustomed to think of what we perceive with our senses as given once for all, and as essentially distinct from our understanding of it. It has been one of the major problems of epistemology how understanding is related to sense, and conception to perception. Latterly psychologists, at least, have ceased to think in such terminology: but the problem of "meaning" is no less urgent, and it is essentially the same problem. And it will, I venture to believe, prove equally baffling, if we continue to think of perception as containing a hard core of sensation to which a variable "meaning" becomes attached. At the perceptual level what a thing "is" and what it "means" are not distinct from each other. Once we fully accept the doctrine that what is perceived is an organized whole, the problem appears in a new light. When I look under the hood of an automobile I see a mass of dirty black iron dripping with grease, the very shape of which is so ill defined that I could not now sketch in vaguest outline what I saw. But my son sees carburetor and timer, starting motor and exhaust manifold, and could, I have no doubt, draw a clear diagram of these parts and their visible structure, although the blackness and dirtiness that catches my eye evidently escapes his. But I could, with instruction and effort, learn to see these parts in their dynamic structure, just as I now see hood and doors and wheels. The understanding of what one sees is not something externally added on, but it enters into and transforms the whole down to its last details.

Now it does not need argument to prove that without language we should none of us come to understand the sensible world about us. It is through the conceptual analysis effected by language that I may come to understand the construction of the automobile engine, and it has similarly been through the agency of language that we all acquired in childhood an understanding of the common objects of daily life. But the sights and sounds of everyday have not only acquired meaning in this way: they have also, through the analysis and synthesis effected by speech, become perceptually differentiated and organized as the objects and events we now see. Of course it is not language in isolation that has accomplished this transformation. But language does not exist in isolation from the culture of which it forms the chief vehicle. It is impossible to learn the language of an alien culture merely from grammar and dictionary. One really acquires a language only insofar as he acquires a culture. Otherwise, as Rousseau says, one may only speak French in six languages. It might well be argued that men of widely differing cultures and modes of speech perceive in correspondingly different terms. The Eskimo, for example, who discriminates by name a dozen varieties of snow surface and formation, each of which has for him its distinctive significance, must see a different landscape from that which meets the eye of the European traveler to the Arctic. But while this might be argued, the thesis here maintained is simpler: that man's ability to use language implies a perceptual experience fundamentally different in its content and organization from that possessed by any other animal.

Considered merely as a mode of discriminatory response, speech is unique. By speech it is possible to respond directly and specifically to an object as such, or even to a quality or relation as distinguished from what is qualified or related. Even the gesture of pointing cannot discriminate the object as such from its spatial location, while it is obviously impossible to point to a quality or a relation. But a word is not merely a vocal gesture which discriminates an object from its location or a quality from an object. By naming something a "tree," for example, I at once distinguish it as an object from its setting, and identify it as a member of a familiar system, in which "bark," "branches" and "leaves" each has its place, as well as "shade," or "ax" and "firewood," as the case may be. How much of this actually enters into perception at any one time depends on occasion and circumstance. But if I see it is a "tree," the content of my perception

is so organized that every sensory detail of hue and brightness and contour is incorporated within it as qualifying just that whole. If I scrutinize it more closely, still regarding it as a "tree," fresh details emerge, each of which continues to have its place within the determining pattern. Thus I perceive more clearly the texture of the "bark," the color and form of the "leaves," etc. In such a case language serves to patternize perception, to determine the general framework into which sensory detail will fit.

But not all our perceptual experience is verbalized in so explicit a fashion. Human perception occurs on different levels. To look at something with a definite view to describing in language what one sees is to see with fresh eyes. What is seen takes on a noticeable transformation. Such explicitly verbalized perception is rare. I may indeed not see the tree as a "tree" at all, but only vaguely as an object to be avoided in my walk, and having no determinate color, shape or size. In such moments we doubtless approach more nearly an animal type of perception. Yet even here there is something distinctly human, in that later I may recall "that I met an obstacle in my path." The influence of language on perception is not limited to what may be termed "verbalization." What as men we see and hear and feel is already such that it *may become* verbalized. The specific organization that accompanies explicit verbalization is not an act of special creation *de novo*. It occurs as a natural development of what is already prepared.

GRACE A. DELAGUNA

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CHANGES IN THE INCIDENCE OF MORTALITY AT ADVANCED AGES

It is a well known fact that the improvement in the general death rate which has been coincident in time with public health efforts has been chiefly associated with marked decreases in the mortality at early ages, and particularly during infancy. One necessary numerical consequence of this must be an alteration of the incidence of mortality at higher ages, unless there has occurred at the same time an actual lengthening of the total span of individual human life, as

distinguished from an increase in the average duration of life of the population. There is no evidence that there has been any such biological alteration in the span of life.

It is of some interest to see what has been happening in the mortality at higher ages, and to this end Tables 1 and 2 have been prepared. The data are from *Mortality Rates* 1910–1920, published by the Bureau of the Census. Table 1 shows for certain important causes of death, the death rates per 100,000 for the age group 65–74, in 1910 and in 1920, for the same area, namely the Registration States of 1910. From these figures are calculated the percentage changes in the mortality rates in this age group in the period 1910–1920. The age group 65–74 may first be considered. These are by no means enormously high ages. But the specific rates here have sufficient reliability

TABLE 1

Death Rates per 100,000 *Enumerated Population, in the Age Group* 65–74, *for the Registration States of* 1920, *in the Period* 1910 *to* 1920, *together with the Percentage Changes in these Rates. Both Sexes*

CAUSE OF DEATH	DEATH RATE IN 1910 AGE 65–74	DEATH RATE IN 1920 AGE 65–74	PERCENTAGE *increase* 1910–1920	PERCENTAGE *decrease* 1910–1920
All causes	5597.37	5429.04	.....	3.01
Typhoid fever	16.90	4.45	.....	73.67
Influenza	91.35	124.20	35.96	.....
Tuberculosis of the lungs	182.57	134.07	.....	26.57
All other tuberculosis	22.40	12.20	.....	45.54
Cancer and other malignant tumors	545.68	671.45	23.05	.....
Diabetes	105.27	129.71	23.22	.....
Cerebral hemorrhage and softening	684.86	786.08	14.78	.....
Organic disease of the heart	1106.70	1198.86	8.33	.....
Pneumonia (all forms)	469.30	425.33	.....	9.37
Diarrhea and enteritis	126.43*	54.64*	.....	56.78
Acute nephritis and Bright's disease	640.55	664.26	3.70	.....
Violent deaths (suicides excepted)	171.68	170.66	....	0.59
All other causes,**	1487.75	1078.26	.....	27.52

* These rates are for age 65 and over.

** Except measles, scarlet fever, whooping cough, and diphtheria and croup.

to make secular comparisons fairly trustworthy. The same cannot be asserted with quite as high a degree of assurance for the 75 and over group.

From Table 1 the following points are to be noted:

1. With the exception of pneumonia and the "all other causes" group the causes of death which showed a decline in the period 1910–1920 are statistically unimportant causes in the age period 65–74. Thus typhoid fever mortality declined 74 per cent in the period, but at ages 65–74 typhoid fever was an insignificant cause of death in 1910.

2. The causes of death which individually are of outstanding importance in the age period 65–74 are cancer, cerebral hemorrhage, heart diseases, kidney diseases, and pneumonia. All of these except pneumonia showed an increase in their mortality in the period of time covered. Diabetes did also.

3. In general the causes of death which appear in the *decrease* column of Table 1 are diseases in which improvement of the environmental situation is attended by beneficial results. On the other hand, those figuring in the *increase* column are chiefly diseases in which the biological constitution of the individual probably plays a significant rôle. And it is the latter that are more important, in the age group 65–74. Improved sanitation, or environmental improvements of whatever sort, are plainly not doing much in lowering further the mortality in this age group. But with better understanding of these diseases there seems no reason to suppose that intelligent alteration of personal and public hygiene, and of the environment generally, intelligently directed to this end, will not reduce the mortality from such things as heart diseases, kidney diseases, and others in this group, at least to some extent.

Table 2 is constructed on the same plan as Table 1, and from the same sources. It presents the facts regarding the mortality at ages of 75 years and upwards. Here are included all the real *Greisen.*

No detailed discussion of Table 2 is necessary. It shows essentially the same things that Table 1 did for the 65–74 group.

The net conclusion is that in the period 1910–1920, and in the registration states of 1910, the mortality rates among aged persons *increased* in respect of those causes of death which are individually most important at advanced ages. The only exception to this statement is furnished by pneumonia, which is an important cause of death at advanced ages. The mortality rate from this cause was lower in 1920 than in 1910. With this exception the individual causes of death

TABLE 2

Death rates per 100,000 *Enumerated Population, in the Age Group* 75 *and over, for the Registration States of* 1910, *in the Period* 1910 *to* 1920, *together with the Percentage Changes in these Rates. Both Sexes*

CAUSE OF DEATH	DEATH RATE IN 1910 AGE 75 AND OVER	DEATH RATE IN 1920 AGE 75 AND OVER	PERCENTAGE *increase* 1910–1920	PERCENTAGE *decrease* 1910–1920
All causes	14,122.1	13,795.4	.....	2.31
Typhoid fever	14.0	2.0	.....	85.71
Influenza	331.8	271.4	.....	18.20
Tuberculosis of the lungs	158.6	114.6	.....	27.74
All other tuberculosis	21.8	16.0	.....	26.61
Cancer and other malignant tumors	764.4	971.5	27.09	.....
Diabetes	107.6	142.0	31.97	.....
Cerebral hemorrhage and softening	1,689.7	2,076.0	22.86	.....
Organic diseases of the heart	2,530.1	3,251.2	28.50	.....
Pneumonia (all forms)	1,149.2	1,054.0	.....	8.28
Diarrhea and enteritis	126.43*	54.64*	.....	56.78
Acute nephritis and Bright's disease	1,244.0	1,577.9	26.84	....
Violent deaths (suicides excepted)	481.5	508.5	5.61	.....
All other causes**	5,365.3	3,691.1	.....	31.20

* These rates are for age 65 and over.

** Except measles, scarlet fever, whooping cough, and diphtheria and croup.

which showed a decline in rate of mortality in the period examined, were causes which are statistically unimportant in the old age portion of the human life span. The figures of Tables 1 and 2 may be looked upon as formulating a petition to medicine and public health to do for the last quarter of the life span the equivalent of what has been done for the first quarter.

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CHURCH MEMBERSHIP AND THE HOMICIDE RATE

Once in ten years the Bureau of the Census, in accordance with the provisions of the Census Act of 1902, takes a census of religious bodies. In this is tabulated, with other information, the number of members of each denomination in each state. The latest of these censuses was taken in 1926, and its results are now appearing in bulletins treating of the various denominations. In Table 1 are given the percentages of the total populations of the several registration states of 1922 who are members of any religious body, as well as the percentages for certain important denominational groups. Table 1 also gives the death rates from homicide in 1922 among the white populations of these states. These latter are taken from Table III A of Mortality Statistics 1922.

TABLE 1

STATE	HOMICIDES PER 100,000 POPULATION WHITE 1922	PERCENT OF POPULATION 1926			STATE	HOMICIDES PER 100,000 POPULATION WHITE 1922	PER CENT OF POPULATION 1926		
		ALL RELIGIOUS BODIES	ROMAN CATHOLICS	METHODISTS AND BAPTISTS			ALL RELIGIOUS BODIES	ROMAN CATHOLICS	METHODISTS AND BAPTISTS
Wyoming	14.3	26.7	8.1	4.6	Pennsylvania	4.6	54.2	22.1	7.9
Tennessee	10.7	41.2	1.0	30.3	New York	4.5	60.1	27.6	5.3
Colorado	10.6	33.3	11.9	7.5	Washington	4.4	25.0	7.9	4.9
California	9.5	36.3	16.7	5.2	District of Columbia	4.0	45.2	12.7	17.0
Louisiana	9.2	54.0	30.6	19.2	Indiana	4.0	44.3	10.0	14.2
Georgia	8.6	43.0	0.6	38.6	New Jersey	4.0	51.3	27.4	7.0
South Carolina	8.4	47.8	0.5	40.9	Delaware	3.5	45.9	15.4	18.6
Kentucky	8.4	41.7	7.0	24.0	Michigan	3.4	40.7	19.2	6.2
Missouri	8.3	45.2	14.8	15.2	Nebraska	3.2	40.5	11.2	8.5
Illinois	7.8	46.6	18.8	8.7	Minnesota	3.1	48.4	18.0	4.0
Mississippi	7.6	44.7	1.8	39.1	Idaho	3.1	31.2	4.4	3.9
Virginia	6.9	46.5	1.5	34.1	Connecticut	2.7	59.6	34.7	4.4
Montana	6.6	21.9	10.6	3.0	Massachusetts	2.4	59.6	38.8	4.5
Kansas	5.9	42.1	9.4	14.4	Rhode Island	2.0	65.1	46.9	4.7
Ohio	5.4	43.4	14.7	10.0	Maine	1.7	37.2	22.0	7.0
Utah	5.2	71.9	2.9	0.7	Wisconsin	1.7	51.1	22.8	3.4
North Carolina	5.1	49.2	0.2	39.1	New Hampshire	1.6	49.3	32.4	6.1
Maryland	4.8	48.0	14.8	14.3	Vermont	1.1	45.7	25.3	7.6
Oregon	4.8	26.5	6.4	6.3					

What is the correlation between percentage of church membership and the homicide rate? We should expect *a priori* that the correlation would be negative, that where a large proportion of the population belongs to organizations devoted to the inculcation of peace on earth, good will to men, few homicides should, in theory, be committed. Nor are we disappointed in this expectation. The correlation between homicide rate and the percentage of church members in the population is $-0.340 \pm .098$, a negative correlation, and, although not large, probably a significant one, being between three and four times its probable error. In other words, states with large proportions of church members have on the average *lower* homicide rates than states with small proportions.

Does this finding apply in equal degree to the different religious groups? The most important, numerically, of these in the United States are the Roman Catholics and the Protestants. The latter group is split up into many denominations, of which the largest, and in many respects the most typical of American Evangelical Protestantism, are the Methodists and the Baptists. I shall therefore use the combined membership of the various Methodist and Baptist bodies in my calculations.

For the proportion of Roman Catholics in the population the correlation with homicide rate is $-0.493 \pm .083$, again negative and higher than for all religious bodies, being 5.9 times its probable error. States with large proportions of Roman Catholics have on the average *lower* homicide rates than states with small proportions.

For the Methodists and Baptists, on the other hand, the result is different. For them the correlation with homicide rate is $+0.389 \pm .097$, a positive correlation of four times its probable error. In other words, states with large proportions of Methodists and Baptists have on the average *higher* homicide rates than states with small proportions.

I do not wish to draw from this result the conclusion that membership in a Methodist or Baptist church predisposes a man to commit murder. It may be that in such states as Tennessee and South Carolina the high homicide rates are due to the 60 or 70 per cent of the population who are not Methodists or Baptists, and that the members of those churches are as little addicted to homicide as so many Vermonters. However, when an organization is so strong as to include a third or more of the total population of a community, the natural expectation is that its teachings will affect the *mores* of the community as a whole,

non-members as well as members. The conclusion is, I think, justified that if the teachings of the churches have any appreciable influence on the homicide rate—a point on which there might be some doubt—then the Methodists and Baptists, typical Evangelical Protestant churches, are less successful than the Roman Catholics in the inculcation of the commandment, "Thou shalt not kill."

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QUOTATIONS

JOHN HUNTER ON APPETITES AND AGING

John Hunter, the great surgeon, was one of the most versatile of men intellectually. No aspect of biology was outside his interests. He was first of all a surgeon with a large practice. To this was added extensive and prodigiously laborious researches on comparative anatomy, and the building up of his museum. General zoology was another major interest. For many years his teaching went along at the same time, on a schedule which would nowadays be regarded, in itself alone, as a sufficient occupation for a busy professor. Altogether Hunter must be regarded as a grand example of an all-round human biologist.

Unfortunately, no complete record of Hunter's writings is available to us. The reason is a curious one. Hunter died on October 16, 1793, in his sixty-sixth year. In February of 1792 Mr. William Clift (who later became Conservator of the Museum of the Royal College of Surgeons) came to Hunter as his apprentice, and continued as such during the year and a half until his death. Of his occupation he says: "During that period I was employed every evening in writing for him." Until 1800 all the Hunterian collections and manuscripts were the property of the executors of John Hunter, but were left in Hunter's house, in the actual custody of Clift. The executors were Dr. Baillie and Sir Everard Home, the brother of Hunter's wife. Home was the active executor. At the beginning of 1800 the collections of specimens were transferred to the custody of the Corporation which is now the Royal College of Surgeons, having been purchased by Parliament. But just prior to the transfer of the collections, the manuscripts were, in Clift's words, "taken by me in a car to Sir Everard Home's house by his order." Nothing more was heard of them for more than twenty years.

In July 1823 for the first time Clift (or anyone else) learned that this wagon load of Hunterian manuscripts had all been destroyed. He was coming home from a meeting of the Medico-botanical Club with Home, and relates that "Sir Everard Home began by telling

me that an accident had very nearly occurred at his house; that it had been nearly on fire; that the engines came, and the firemen insisted upon taking possession of his home. They saw the flames coming out of the chimney. He did not wish to admit them, but they insisted

JOHN HUNTER, F.R.S.

upon being admitted. I asked him how it happened, and then he told me that it was in burning those manuscripts of Mr. Hunter.

"The Board of Curators of the College of Surgeons obtained a knowledge of the existence of those papers, and that Sir Everard Home had in his possession all Hunter's manuscripts, from Sir Everard Home himself, whilst he was a member of that Board."

Home had said nothing to the Curators about having destroyed the papers, but after Clift informed them of what he had learned Home sent in the following letter:

"Sackville Street, March 9th, 1824.

"Sir,—I beg you will acquaint the Board of Curators, that Mr. Hunter desired that, after his death, his manuscripts should not be entrusted to anybody, but were to be destroyed, being in too imperfect a state for the public eye.

"With a view to afford every material that could assist in the formation of the Catalogue, I spent my leisure hours in the Museum for ten years, taking every assistance these papers could afford, and at the end of thirty years, my own health becoming precarious, I closed my executorship by destroying them.

"I am Sir, yours truly,
"Everard Home."

"Mr. Balfour, Secretary, Royal College of Surgeons."

It was at the time suspected* that Home's real reason for this act of vandalism was that he had used Hunter's records as the basis for papers published under his own name, and felt that burned papers can prove no plagiarism. But the case was not so simple. In the years from 1793 to 1800 Clift had copied a good deal of Hunter's manuscript material. He estimated that he had in this way copied roughly a half of all the papers that were turned over to Home. Many years later Clift turned over these copies of Hunter's papers which he had made to his son-in-law Richard Owen, the great anatomist, to do with as he liked. He prepared a two volume work in octavo, of which the title page, in reduced facsimile, is here reproduced.

These volumes contain a great deal of present day interest. It has seemed desirable to choose for quotation a passage in the portion dealing with psychology.

Periods of Life, according to Appetites and Mental Operations

The Life of man may be divided into three great periods: viz.' youth,' 'middle-age,' and 'old age.' In considering these three different stages of life, both as to

*Cf. Life of Richard Owen, Vol. II, pp. 109ff, 1895; Charlesworth's Geological Journal, 1846: F.H. Butler, *Enc. Brit.*, Vol. 13, Art. John Hunter; and many other sources, including especially the Appendix to Owen's edition of the *Essays and Observations* cited below.

ESSAYS AND OBSERVATIONS

ON

NATURAL HISTORY, ANATOMY, PHYSIOLOGY, PSYCHOLOGY, AND GEOLOGY.

By JOHN HUNTER, F.R.S.:

BEING

HIS POSTHUMOUS PAPERS ON THOSE SUBJECTS,

ARRANGED AND REVISED, WITH NOTES:

TO WHICH ARE ADDED,

THE INTRODUCTORY LECTURES
ON THE HUNTERIAN COLLECTION OF FOSSIL REMAINS,

DELIVERED IN

THE THEATRE OF THE ROYAL COLLEGE OF SURGEONS OF ENGLAND,

MARCH 8TH, 10TH, AND 12TH, 1855:

By RICHARD OWEN, F.R.S., D.C.L.,

SUPERINTENDENT OF THE NATURAL HISTORY DEPARTMENTS, BRITISH MUSEUM;
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VOLUME I.

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JOHN VAN VOORST, PATERNOSTER ROW.
MDCCCLXI.

constitution and disposition, we shall find that there is a gradual and imperceptible change always taking place; the first going gradually into the second, and the second as gradually into the third; so that there is no particular period between any two of them, whereby we can terminate the one and begin the other. Therefore we shall consider these periods when in their full maturity; and, as we proceed, shall consider the gradual changes into the next; as where the first is gaining, then losing, while the second is gaining, etc. But as these gradual changes are not so much, or so directly, to our present purpose, they will only be mentioned as circumstances taking place, that may, in some degree, throw a light upon our subject.

The first period of a man's life is [passed in] the enjoyment of its natural appetites and sensations, and [in] extending the actions naturally arising out of the union of the body and mind. The mind is constantly receiving impressions by its senses, and constantly forming new ideas, laying up a store of sensations and ideas; but, at first, without form or method.

New appetites are arising as the parts are becoming more fit for their peculiar sensations and enjoyments, which are always more vigorous in their early stages. So that a young animal is extremely active with regard to bodily action; being fitted for sensations and constantly in pursuit of them; yet it is extremely passive with regard to the combinations of the mind; it is just a being receiving impressions, thinking but little of the past; because the present enjoyment, and the future which is nigh, are the highest sensations of the body and the mind. These natural appetites are never improved; they are most perfect at the first, and will always be the most vigorous when the mind is least engaged, or when there is no mind at all. The natural or necessary appetites are limited; they are such as always destroy themselves by enjoyment, but are renewed again by the body recurring to its natural state.

This is the age that in some degree bespeaks the future with respect to intellect; it is the age that in most cases distinguishes the young man of feeling, sensibility, quickness of apprehension, from the idiot. The [state of the] idiot is one where impression produces sensation, not upon the mind, but upon the body; where the mind never makes an application of the present sensation to another; and where, when the present sensation is gone, it never recurs.

When the appetites for any one thing are vigorous, they carry us great lengths; but they are not lasting; for some new object of appetite appears, and destroys that for the former [object]. An appetite has but one fixed point in view: it is simple enjoyment. If it be the appetite of eating, it is intent only on eating; and if it fixes the mind on one kind of food, that desire cannot last long, for other food will exactly answer the same purpose. Or, if that [kind of food] is not sufficient at the time, hunger will come in and reconcile the whole; so that no man can think of any one kind of food for twelve hours. Therefore the simple disappointment of any one kind of food cannot long affect the mind; and, whatever may be the strength of a man's relative quality for any one kind of food more than another, it will be annihilated when he is set down to twenty dishes.

The same observations are equally just with regard to other appetites; only that for food, although the most essential to life, is the one that will produce the least effect upon the mind; and that arises entirely from its being the most essential. The other appetites, being less essential to life, allow the mind to dwell upon them;

and, to gratify them in a particular manner becomes more an act of the mind than in the appetite for food. The enjoyment can be suspended in case all the relative qualities (either imaginary or real) are not present; and these relative qualities are more peculiarly mental than simple enjoyment is.

A man has an appetite to enjoy a woman; but if the mind has formed itself to any particular woman, the appetite or enjoyment can be suspended till that object is presented; and the more the mind interferes, the greater stress will be laid upon this relation; the more sexual enjoyment will be almost forgot, and the whole pursuit will be after the particular quality of the appetite. But, perhaps, it requires long habit to establish the influence of such a relative quality in the mind.

Such is the state of youth till man arrives at full possession of all his appetities and sensations. Then he is in full powers of enjoying them; and, in this state of possession, he goes on for years; but his temporary appetites, as venery, become in time blunted, and often in some degree his essential ones, as that for food; and he begins to lose the substance in pursuit of the qualities, refining away the natural man, becoming rather ideal; whence arise 'taste,' 'graces,' etc.

The man begins to combine the sensations, and form ideas more extensive. From reasoning, he looks further forward; which, in a proportional degree, lessens the present [enjoyment], except it be connected with the future. He is considering substantials for the future, which always takes in a much greater scope of reasoning as there are always a greater number of relative circumstances. He not only considers substances, but the qualities of substances, and endeavours to investigate, separate, arrange, and combine these qualities.

All these actions are of the mind; and as they took their origin from the nervous system, they continue to belong to it.

The mind now becomes the principal actor. It is viewing objects in all their different forms and relations; and, as futurity has both a good side and a bad one, the mind is apt to be more impressed with the one or the other, seldom steering in the middle. These different views of things will arise either from natural, or constitutional, or habitual causes.

It may be put down, as a rule, that everything in this world is absolute: but, as all the leading causes of things cannot be seen, because they appear to depend upon circumstances that are unknown, or appear to be accidental, therefore the mind cannot lead up to the absolute. It is influenced by some impression, arising out of the present appearances, which may be totally different from the effect that is to take place; and so the present probability, on one side or the other, determines the mind.

Thus, then, the futurity visibly left to be undetermined even to the mind of the most sanguine, which is perhaps the most weak. It leaves in the mind a strange disagreeable uncertainty, which the pursuit of present enjoyment does not produce; because the nearer an event is to happen, in the same proportion it seems the more certain to happen.

This age is the perfect age of man; and, as a medium, may be said to begin at thirty years and to end at fifty years.

This is the age in which the mind is truly employed; the age in which both the fear of disappointment, and disappointment, make a lasting impression, because the object to be gained is not momentary or immediate. Time hardly establishes a security; it rather exposes an uncertainty.

This is the age of madness; or when, usually, insanity takes place.

As people draw towards perfection they become more and more nervous: the nervous age is at about thirty or forty years; but as they go on towards the decline of life, they lose that sensibility. This is equally applicable to both mind and body.

One, at first, would suppose that the nervous state of body would be the young state; but it is not: this is a state rather of indifference to impression, although it may be felt acutely; there is too much love of variety to dwell long upon any one object; it is an age which feels quickly, but forgets soon.

Thirty is the time when objects begin to last, when they begin to make an impression, when they take possession of the mind. Fifty is the age when indifference about all objects begins to take place; an insensibility creeps on, the effect of which is similar to the first stage, although arising from very different causes.

Belief in general is stronger in children than in old people, although children are often deceived; yet the fondness for the thing carries them beyond reflections and remembrance of past deceits.

Young people like sugar; old people like pepper.

R. P.

RECENT LITERATURE

USEFUL IN THE STUDY OF HUMAN BIOLOGY

In this department will be noticed the books and reprints which are currently received at the Editorial Office. Publications intended for notice here should be addressed to Dr. Raymond Pearl, Institute for Biological Research, 1901 East Madison Street, Baltimore, Maryland, U. S. A.

I. EVOLUTION AND GENETICS

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INDEX

Absurd sentence test, 87
Age changes in pigmentation, 334
Aging and appetites, 565
American notables, ecology of, 544
Analysis of personality, 131
ANATOMICAL Expedition to Africa, 423–425
ANDERSON, D. DRYSDALE, Point of Population Saturation, 528–543
Anomalies, developmental, and primogeniture, 382
Anthropometric methods, 37
Ape-man, is he a myth?, 4, 153
Aphasia, 418
Appetites and aging, 565
Army Alpha tests, 88
Assembling of records in constitution study, 52

BAKWIN, HARRY, Sex Factor in Infant Mortality, 90–116
BARNES, IRENE, Inheritance of Pigmentation in American Negro, 321–381
BEHAVIOR (Recent Literature), 147, 294, 436, 577
Behavior, primitive, reversion to from organic brain disease, 406
BERKSON, JOSEPH, Growth Changes in Physical Correlation, 462–502
Binet tests, 87
Biological factors in negro mortality, 229
  philosophy and medicine, 117
Brain disease, organic, causing reversion to primitive behavior, 406
Brewery employees, mortality of, 136
Browne, Sir Thomas, on physiognomy, 283

Cancer in white and colored, 231
Causes of death, organological classification, 237
Chest-circumference, biometric constants, 462
Children, desire for as factor in selection, 512
Church membership and homicide rate, 562
Classification by disease groups, 126
Climate and birthplace of notables, 545
Clinical records in constitution study, 26
Compulsions, 514
Congenital anomalies, 278
Constitution studies, methods, 10
Constitutional somatology, 283
  types, 130
Correlation, physical, growth changes in, 462

Cox, Eugene A., Political Parsons, 284–285
Cradle of man, 5
Craniology, Mongolian, 421
Mr. Cranium's lecture, 139
Cross, John, M.D., on physiognomy and constitution, 426

Davenport, C. B., Do Races Differ in Mental Capacity?, 70–89
Davenport, C. B., 322, 326, 363
Death rate and mortality sex ratio, 97
Developmental anomalies and primogeniture, 382
Differential survival rate, 508
Difficulties of ape-man theory, 4, 155
Disease as maladjustment of organism and environment, 122
  reactive process, 450
  personification of, 123
Dittrich, R. J., Congenital Anomalies, 278–282
Doctor and patient, relation between, 459
Dominance of N pigmentation, 361
Draper, George, Biological Philosophy and Medicine, 117–135
Drawing test, 81
Dryopithecus, 155, 158

Ecology of American notables, 544
Endogamy, 254
Environment and response, 118
Environmental factors influencing mortality sex ratio, 100
Eugenic character of selection, 506
Eugenics *circa* 590 B.C., 142
Evolution and Genetics (Recent Literature), 144, 286, 431, 572

Field work in constitution study, 51
First-born, handicapping of, 382
Flexion reflex, 409
Folded paper test, 83
Foreword, 1
Form-board test, 83
Freeman, Walter, Reversion to Primitive Behavior Resulting from Organic Disease of the Brain, 406–420

Generations, spread of, 305
Genetic records in constitution study, 19
Geographical differences in mortality sex ratio, 100
Geometric test, 79
Gover, Mary, Increase of Negro Population in United States, 263–273
Grasping reflex, 415
Gregory, William K., Is the Pro-Dawn Man a Myth?, 153–165
Group Biology (Recent Literature), 145, 289, 433, 574

Growth changes in physical correlation, 462
curves of negro and white populations, 263
and development, 128

Headlong Hall, 139
Heart defects, congenital, 396
disease and height-weight, 166
Height, biometric constants, 462
-weight standards, 190
Herskovits, M. J., 324, 327
Herskovits, Melville J., Social Selection and the Formation of Human Types, 250–262
Home environment records in constitution study, 45
Homicide rate, 274
and church membership, 562
Human types, formation of, 250
Hunter, John, on appetites and aging, 565

Increase of negro population in United States, 263
Industrial applications of spread of generations, 317
Infant mortality, sex factor in, 90
Inheritance of pigmentation in negro, 321
Injury, secondary effects of, 120

Japanese vital indices, 198

Knox moron test, 83

de Laguna, Grace A., Perception and Language, 555–558
Language and perception, 555
Laughing, pathologic, 417
Le Blanc, Thomas J., Specific Vital Indices for Japan, 198–213
Longcope, Warfield T., The Sick Man, 445–461
Lotka, Alfred J., Spread of Generations, 305–320
Love, Albert G., Somatological Norms in Tuberculosis and Heart Disease, 166
Lower classes, are they inferior?, 509

Macklin, Madge Thurlow, Primogeniture and Developmental Anomalies, 382–405
Mauritius, population saturation in, 528
Medical specialization, benefits and dangers of, 447
Medicine and biological philosophy, 117
Mental capacity, do races differ in?, 70
condition of patient, 451
tests, 70
Methodology (Recent Literature), 152, 303, 443, 587
Methods in constitution study, 10
Michelson, Truman, Notes on Mongolian Craniology, 421–423

Miner, John R., Church Membership and the Homicide Rate, 562–564
Nativity and Parentage of the Population of the United States and the Homicide Rate, 274–278
Mineral wealth and birthplace of notables, 548
Miscarriages in first pregnancy, 399
Miscellaneous (Recent Literature), 152, 303, 444, 588
Mongolian craniology, 421
Morbidity, infant, sex factor in, 91
Morphology (Recent Literature), 149, 297, 439
Mortality at advanced ages, 558
of brewery employees, 136
infant, sex factor in, 90
negro, biological factors in, 229
Movement, beginnings of, 407

Natural selection in population growth, 503
Negro, inheritance of pigmentation in, 321
mortality, biological factors in, 229
physical features, 57
population in United States, 263
social definition of, 255
selection in, 260
Notables, American, ecology of, 544
Notes, 136–138, 274–282, 421–425, 555–564
Number repetition test, 86

Obsessions, 514
Organological classification of causes of death, 237
Osborn, Henry Fairfield, Is the Ape-man a Myth?, 4–9

Pathology (Recent Literature), 151, 301, 441, 585
Peacock, Thomas Love, on craniology, 139
Pearl, Raymond, Biological Factors in Negro Mortality, 229–249
Changes in the Incidence of Mortality at Advanced Ages, 558–561
Constitutional Somatology, 283–284
Mr. Cranium's Lecture, 139–142
Dr. John Cross on Physiognomy and Constitution, 426–430
Foreword, 1–3
John Hunter on Appetites and Aging, 565–571
Mortality of Brewery Employees, 136–138
Pearl, Raymond, *et al.*, Studies on Constitution. I. Methods, 10–56
Pelvis, white and negro, 61
Perception and language, 555
Personality, alterations of in disease, 458
analysis, 131
Photographic records in constitution study, 18, 40, 44
Phylogenetic principles, 7, 160
Phylogeny of the Primates, 214
Physiognomy, 426

PHYSIOLOGY (Recent Literature), 150, 299, 440, 584
Pigmentation, age changes in, 334
  inheritance in negro, 321
  measurement, technique, 322
Pithecanthropus, 5, 155, 158
Political parsons, 284
Population growth, natural selection in, 503
  saturation, 528
Postural reactions, 410
Primate phylogeny, 214
Primitive behavior, reversion to, from organic brain disease, 406
Primogeniture and developmental anomalies, 382
Pro-dawn man, is he a myth?, 153
Pylorus, congenital hypertrophy of, 393

QUOTATIONS, 139–143, 283–285, 426–430, 565–571

Races, do they differ in mental capacity?, 70
Racial susceptibility to disease, 125
RECENT LITERATURE, 144–152, 286–304, 431–444, 572–588
Reconstruction test, 81
Regression of pigmentation of offspring on parents, 342
Religio Medici, 283
Reversion to primitive behavior from organic brain disease, 406
Rhythm discrimination, 78
Rigor of selection today, 505

Saturation of population, 528
Seashore test of time and rhythm discrimination, 75
Seasonal variations in mortality sex ratio, 104
Secondary effects of injury, 120
Selection in population growth, 503
Sensibility, primitive, 418
Settlement, stage of, and birthplace of notables, 550
Sex factor in infant mortality, 90
Sexual history in constitution study, 31
  selection, 253
Sick man, 445
Skull, primate, two types of, 216
SMALLWOOD, W. M., Eugenics *circa* 590 B.C., 142–143
Social selection, 250
Soil and birthplace of notables, 549
Somatological norms in tuberculosis and heart disease, 166
SOMATOLOGY AND CONSTITUTION (Recent Literature), 582
Spread of generations, 305
Still, G. F., 383
Still-births, sex factor in, 92
Survival rate, differential, 508

Susceptibility, racial, 125
Synkinesis, 412

Tanala, 258
Tarsier-monkey phylum, 224
Technique of pigmentation measurement, 322
Tennessee, constitution of, 284
Theognis, 142
THOMPSON, WARREN S., Natural Selection in the Processes of Population Growth, 503–513
Time discrimination, 75
Todd, T. W., 324
TODD, T. WINGATE, Entrenched Negro Physical Features, 57–69
Topography and birthplace of notables, 548
Tree shrew-lemur phylum, 223
Tuberculosis and height-weight, 166

Unreality, feelings of, 514
Upper classes, are they superior?, 510
Urban and rural mortality sex ratios, 102

Variability in hybrid and purer stocks, 66
pigmentation, 350
VISHER, STEPHEN S., Ecology of American Notables, 544–553
Vital indices for Japan, 198

Wealth distribution and birthplace of notables, 547
Weeping, pathologic, 417
Weight, biometric constants, 462
WOOD-JONES, FREDERIC, Phylogeny of the Primates, 214–228

ZIEGLER, LLOYD H., Compulsions, Obsessions and Feelings of Unreality, 514–527

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CONTENTS

THE SICK MAN. *Warfield T. Longcope* 445

GROWTH CHANGES IN PHYSICAL CORRELATION—HEIGHT, WEIGHT, AND CHEST CIRCUMFERENCE—MALES. *Joseph Berkson* 462

NATURAL SELECTION IN THE PROCESSES OF POPULATION GROWTH. *Warren S. Thompson* 503

COMPULSIONS, OBSESSIONS AND FEELINGS OF UNREALITY. *Lloyd H. Ziegler* 514

THE POINT OF POPULATION SATURATION. ITS TRANSGRESSION IN MAURITIUS. *D. Drysdale Anderson* 528

ECOLOGY OF AMERICAN NOTABLES. *Stephen S. Visher* 544

NOTES. *Perception and Language. Grace A. de Laguna* 555

Changes in the Incidence of Mortality at Advanced Ages. Raymond Pearl 558

Church Membership and the Homicide Rate. John R. Miner 562

QUOTATIONS. *John Hunter on Appetites and Aging* 565

RECENT LITERATURE 572

INDEX 589

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